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THE GIFT OF
Prof. Louis C. Karpinski

Prg. Louis C. Karpinski
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TRE
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OF

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Practical Surveying;

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WHICH IS DEMONSTRATED

FROM ITS FIRST PRINCIPLES.

WHEREIN

Every Thing that is Useful and Curious in that Art,

IS FULLY CONSIDERED AND EXPLAINED, PARTICULARLY

THREE NEW AND VERY CONCISE METHODS FOR DETERMINING THE AREAS OF RIGHT-LINED FIGURES, ARITHMETICALLY OR BY CALCULATION, AS WELL AS THE GEOMETRICAL ONES HERETOFORE TREATED OF.

The whole illustrated with Copper-plates.

THE NINTH EDITION.

BY ROBERT GIBSON, TEACHER OF THE *MATHEMATICS.*

WITH ALTERATIONS AND AMENDMENTS,
ADAPTED TO THE USE OF AMERICAN SURVEYORS.

PHILADELPHIA:
PRINTED BY JOSEPH CRUKSHANK.
1808.

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C. H. C. Castelain

Prof. Louis C. Karpinski
10-19-1925

Advertisement.

THE present Publication being chiefly intended for the American reader, we have taken the liberty of making some alterations, which, it is presumed, will rather prove advantageous than otherwise.

Some parts of the work have been abridged, and other parts totally omitted, as being of little or no use to the American Surveyor. These alterations have enabled the Editor to introduce into the body of the work, some matters of considerable importance in the practice of surveying; amongst which, are a complete set of tables of latitude and departure, to the distance of 100, and to every 15 Minutes of the quadrant; a table of logarithms from 1 to 10,000; and a table of artificial sines, tangents, and secants; also an example of calculating the contents of a survey, according to the method commonly practised in the surveyor general's office of this commonwealth.

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AN INTRODUCTION TO ALGEBRA;

WITH notes and obſervations; deſigned for the uſe of Schools and Places of Public Education. by JOHN BONNYCASTLE, of the Royal Military Academy, Woolwich. *The firſt American edition.*

The American Tutor's Aſſiſtant; or, a compendious ſyſtem of Practical Arithmetic; containing, the ſeveral rules of that uſeful ſcience, conciſely defined, methodically arranged, and fully exemplified. The whole particularly adapted to the eaſe and regular inſtruction of youth in our American ſchools.

PREFACE.

THE word *geometry* imports no more than *to measure the earth*, or to measure land; yet in a larger and more proper sense, it is applied to all sorts of dimensions. It is generally supposed to have had its rise among the *Egyptians*, from the river *Nile's* destroying and confounding all their land-marks, by its annual inundations, which laid them under the necessity of inventing certain methods and measures to enable them to distinguish and adjust the limits of their respective grounds, when the waters were withdrawn. And this opinion is not entirely to be rejected, when we consider that *Moses* is said to have acquired this art when he resided at the *Egyptian* court. And *Achilles Tatius* in the beginning of his introduction to *Aratus*'s *Phænomena*, informs us, that the *Egyptians* were the first who measured the heavens and the earth (and of course the earth first) and that their science in this matter, was engraven on columns, and by that means delivered to posterity.

It is a matter of some wonder, that though surveying appears to have been the first, or at least one of the first of the mathematical sciences, that the rest have met with much greater improvements from the pens of the most eminent mathematicians, while this seems to have been neglected; insomuch that I have not been able to meet with one author, who has sufficiently explained the whole art in its theory and practice: for the most part, it has been treated of in a practical manner only; and the few who have undertaken the theory, have in a great measure omitted the practice.

These considerations induced me to attempt a methodical, easy, and clear course of *Surveying*; how far I have succeeded in it, must be determined by the impartial reader: the steps I have taken to render the whole evident and familiar are as follow:

In section the first, you have decimal fractions, the square root, geometrical definitions, some necessary theorems and problems; with the nature and use of the tables of logarithm numbers, sines, tangents, and secants.

The second section contains plane trigonometry right angled and oblique, with its application in determining the measures of inaccessible heights and distances.

The third section gives an account of the chains and measures used in *Great-Britain* an *Ireland;* methods of surveying and of taking inaccessible distances by the chain only, with some necessary problems; also a particular description of the several instruments used in surveying, with their respective uses.

The fourth section contains two methods of finding the areas of maps from their geometrical construction, more concise than any heretofore made public.

The fifth section contains a new, and much more concise method of determining the areas of surveys from the field-notes, or by calculation than any hitherto published; and I venture to assert that it is impossible (from the nature of right-lined figures) that any method or methods more concise than this, can be investigated.

To these methods is annexed a short table of difference of latitude and half departure, to every degree and quarter of a degree of the quadrant, the stationary distance being one chain; which will be found as ready, by a little practice, and perhaps more exact, than those already published.

Truth calls upon me to acknowledge, that the methods by calculation, herein set forth, got their rise from those of the late *Thomas Burgh*, esq. who first discovered an universal method for determining the areas of right lined figures, and for which he obtained a parliamentary reward. I hope therefore it cannot be construded as an intention in me to take from his great merit, when I say, that the methods herein contained are much more concise and ready than his.

Section the sixth contains the nature of off-sets, and the method of casting them up by the pen: the nature and application of enlarging, diminishing, and connecting of maps: variation of the compass by amplitudes and azimuths, with some of its uses; to which is added, a table of the sun's declination: how to find by what scale a map is laid down, having the map and area given: how to find the content of ground that is surveyed by a chain that is too long or too short: the method of dividing lands: And the whole concludes with some necessary directions and remarks on surveys in general.

THE PRINCIPLES OF SURVEYING.

SECT. I.

Containing Decimal Fractions, the Square Root, Geometrical Definitions, Theorems and Problems; with the Nature and Use of the Tables of Logarithm Numbers, Sines, Tangents, and Secants.

DEFINITION.

SURVEYING is that art which enables us to give a plan, or just representation, of any piece or parcel of land, and to determine the content thereof, in such measure as is agreeable and customary to the country or place where the land is.

This science depends on some parts of the mathematics, which must be known before we can treat of it, wherefore we shall begin with

DECIMAL FRACTIONS.

If we suppose unity, or any one thing to be divided into any assigned number of equal parts, this number is called the denominator; and if we chuse to take any number of such parts less than the whole, this is called the numerator of a fraction.

The numerator in the vulgar form, is always wrote over the denominator, and these are separated by a small line thus $\frac{5}{12}$ or $\frac{7}{12}$ $\frac{\text{Numerator}}{\text{Denominator}}$ the first of these called 5 twelfths, and the latter 7 twelfths of an inch, yard, perch, *&c.* or of whatever the whole thing originally was.

Fractions are expressed in two forms, that is, either vulgarly or decimally.

All Fractions whose denominators do not consist of a cypher or cyphers set after unity, are called vulgar ones, and their denominators are always wrote under their numerators. The treating of these would be foreign to our present purpose. But fractions whose denominators consist of an Unit prefixed to one or more cyphers, are called decimal fractions; the numerators of which are written without their denominators, and are distinguished from integers by a point prefixed: thus $\frac{2}{10}$ $\frac{42}{100}$ and $\frac{172}{1000}$ in the decimal form, are expressed by .2 .42 .172

The denominators of such fractions always consisting of an unit, prefixed to as many cyphers as there are places of figures in the numerators, it follows, that any number of cyphers put after those numerators, will neither increase nor lessen their value: for $\frac{3}{10}$ $\frac{30}{100}$ and $\frac{300}{1000}$ are all of the same value: and will stand in the decimal form thus .3 .30 .300; but a cypher or cyphers prefixed to those numerators, lessen their value in a tenfold proportion: for $\frac{3}{10}$ $\frac{03}{100}$ and $\frac{003}{1000}$ which in the decimal form we denote by .3 .03 and .003, are fractions, of which the first is ten times greater than the second; and the second ten times greater than the third.

Hence it appears, that as the value and denomination of any figure or numbers of figures in common arithmetic is enlarged, and becomes ten or an hundred, or a thousand times greater, by placing one or two, or three cyphers after it; so in decimal arithmetic, the value of any figure or number of figures, decreases, and becomes ten, or a hundred, or a thousand times less, while the denomination of it increases, and becomes so many times greater, by prefixing one, or two, or three cyphers to it: and that any number of cyphers, before an integer, or after a decimal fraction, has no effect in changing their values.

Integers.							Decimals.					
1	2	7	1	6	3	.	5	1	2	3	6	7
Hund. of thous.	Tens of thous.	Thousands	Hundreds	Tens	Units		Tenths	Pts. of a hund.	Pts. of a thous.	Pts. of ten thous.	Pts. of hun. tho.	Pts. of a million

Addition of DECIMALS.

Having placed those figures which are equi-distant from the point (as well integers as fractions) under each other, add them as if they were integers.

EXAMPLES.

Add 4.7832 3.2543 7.8251 6.03 2.857 and 3.251 together. Place them thus,

$$
\begin{array}{r@{}l}
4.&7832\\
3.&2543\\
7.&8251\\
6.&03\\
2.&857\\
3.&251\\
\hline
\text{Answer } 28.&0006
\end{array}
$$

Add 6.2 121.306 .75 2.7 and .0007 together.

121.306
.75
2.7
.0007

Answer 130.9567

What is the sum of 6.57 1.026 .75 146.5 8.7 526. 3.97 and .0271?

Answer 693.5431.

What is the sum of 4.51 146.071 .507 .0006 132. 62.71 .507 7.9 and .10712?

Answer 354.31272.

Subtraction of DECIMALS.

Having placed the figures which are equi-distant from the point, under each other, deduct as if they were integers.

EXAMPLES.

From 38.765 take 25.3741
25.3741

Answer 13.3909

From 2.4 take .8472
.8472

1.5528

From 71.45 take 8.4837248
Answer 62.9662752.

From 84 take 82.3412
Answer 1.6588

Multiplication of DECIMALS

Place the multiplicand and multiplier, after any manner under each other; and having multiplied as in whole numbers, cut off as many places of decimals in the product, counting from the right hand towards the left, as there are in the multiplicand, and multiplier; but if there be not a sufficient number of places in the product, the defect may be supplied, by prefixing cyphers thereto.

For the denominator of the product, being an unit, prefixed to as many cyphers, as the denominators of the multiplier and multiplicand contain of cyphers, it follows that the places of decimals in the product will be as many as in the numbers from whence it arose.

EXAMPLES.

Multiply 48.765 by .003609
.003609

438885
292590
146295

Answer .175992885

Multiply .121
by .14

484
121

Answer .01694

Multiply 121.6 by 2.76

```
      2.76
    ------
      7296
     8512
    2432
    ------
Answer 335.616
    ------
```

Multiply .0089789 by 1085
Answer 9.7421065

Multiply .248723 by .13587
Answer .03379399401

Division of DECIMALS.

Having divided as in whole numbers, annexing cyphers to the dividend if they be wanted; the decimal places in the divisor and quotient must be equal to those in the dividend, and the defect supplied by prefixing cyphers to the quotient.

For the dividend is a product, contained under the divisor and quotient; and that product contains as many places of decimals as the numbers do from whence it arose: therefore, the difference between the number of decimals in the dividend and divisor, must be cut off in the quotient.

EXAMPLES.

Divide .144 by .12

```
.12).144(1.2
     ---
      24
     ---
```

Divide 63.72413456922 by 2718
2718)63.72413456922(.02344522979
9364
12101
12293
14214
6245
8096
26609
21472
24462
. . . . .
Answer .02344522979

There being 11 decimal figures in the dividend, and none in the divisor, 11 figures are to be cut off in the quotient; but as the quotient itself consists of but 10 figures, we prefix to them a cypher to complete that number.

Divide 1.728 by .012
.012)1.728(144
52
48

Because the number of decimal figures in the divisor and dividend, are alike; the quotient will be integers.

Divide 2.00000 by 3.1416

```
3.1416)2.00000(.636618
       -------
        115040
        -------
         207920
         -------
          194240
          -------
            57440
           -------
           260240
           -------
             8912
```

There being 4 decimal figures in the divisor, and 10 including the cyphers brought down in the dividend, the difference, which is 6 figures, to be cut off in the quotient.

Divide 87446071 by .004387.
Answer 199.33.
Divide .624672 by 482.
Answer .001296.
Divide 66.993548 by 27.4.
Answer 2.44502.

PROB. I.

To reduce a Vulgar Fraction to a Decimal one of the same Value.

Having annexed a sufficient number of cyphers as decimals, to the numerator of the vulgar fraction, divide by the denominator; and the quotient thence arising, will be the decimal fraction required.

EXAM-

EXAMPLES.

Reduce $\frac{3}{4}$ to a decimal fraction.
4)3.00(.75 Answer.

20

For $\frac{3}{4}$ of one shilling, yard, perch, *&c.* is equal to one fourth of three shillings, yards, perches, *&c.* therefore if 3 be divided by 4, the quotient will be the answer.

Reduce $\frac{2}{5}$ to a decimal fraction.
5)2.0(.4 Answer.

Reduce $\frac{12}{25}$ to a decimal fraction.
25)12.00(48 Answer.

200

Reduce $\frac{25}{218}$ to a decimal fraction.
Answer .1146789.

PROB. II.

To find the Value of a decimal Fraction, in the known Parts of the Integer.

Multiply the decimal proposed, into the number of equal parts contained in the integer, and the product will be the number of such parts as are expressed by the fraction.

What is the value of .25 of a pound sterling?
20

Answer shillings 5.00

For .25 or $\frac{25}{100}$ of one pound, is equal to the one hundredth part of 25 pounds, or of the shillings in 25 pounds, which are 500; therefore the one hundredth part thereof will be 5 shillings; which is effected by cutting off the two cyphers, for the two decimals, by a point.

What is the value of .385 of a pound sterling?
20

Shillings 7.700
12

Pence 8.400
4

Farthings 1.600

What is the value of .48 of a chain of 50 links?
50

Answer links 24.00

What is the value of .2864 of a shilling?
12

Pence 34.368

4

Farthings 1.7472

What is the value of .287 of a pound weight troy?

	Oz.	dwt.	gr.
Answer	3	8	21

What is the value of .2945 of a pound avoirdupoise?

Oz. dwts.
Answer 4 $11\frac{1}{4}$.

THE EXTRACTION OF THE SQUARE ROOT.

A SQUARE number is the product of a number multiplied by itself; and the number so multiplied, is called the root of that square; thus 9 is the square of 3, and 3 is the root of 9, for 3 multiplied by 3 is 9.

If a square number be given to find its root, observe if the number of figures or places in the given square be odd or even, if they be odd, find the root of the first figure; but if they be even, of the two first; under which place the square of that root, and deduct, placing the root in the quotient, and bring down two figures to the remainder.

Let the double of the said root be made a divisor to all the figures of that last remainder, except the last; put the quotient thereof with the root, or former quotient; and having multiplied it into the numbers so formed, deduct the product from the foregoing figures or resolvend; and in like manner proceed, till all the figures of the given square are exhausted.

If there be any decimals in the given square, their number must be even, or made so, before we begin to find the root, by adding a cypher to the right hand; and for every two places of decimals in the square, let one be cut off in the root.

EXAMPLES.

1. What is the square root of this square number, 298116?

29,81,16(546
25

104)481
416

1086).6516
6516

Because the number of figures in the given square number is even, we find the nearest square number to the two first figures 29, which is 25, the root whereof 5, we set in the quotient, and deduct 25 from 29, and to the residue 4, we annex the following figures, 81, so we have 481, for a resolvend.

The double of the first figure in the quotient being 10, is then set as a divisor to 48, all the figures in the resolvend, but the last; and finding it to be contained 4 times, we annex the 4 to the divisor and quotient; the then divisor, 104, is multiplied by the last figure in the quotient, 4, and the product 416 is deducted from the resolvend 481, to the residue whereof is annexed the two following figures in the square, so we have 6516 for a new resolvend, to all which figures but the last we make 108, the double of 54, the figures in the quotient a divisor, and finding it will be contained 6 times, we place 6 in the divisor and quotient; the then divisor 1086 is multiplied by the last figure in the quotient 6, and the product being set under the resolvend and thence deducted, leaves nothing; so is 546 the root sought.

For if the root 546 be squared or multiplied by 546, the product will be the square number given.

2. What is the square root of 1710864?

```
                  Root.
      1,71,08,64(1308 Answer
      1
     ---
   23).71
       69
     -----
 2608).20864
       20864
       -----
       . . . . .
```

What is the square root of 3857.3?

Here being an odd decimal figure, we annex any odd number of cyphers to make the decimal places even; and then extracting the root as before, we thence cut off half the number of decimals that we have in the square. Thus,

```
                   Root.
      3857.300000(62.107 Answer.
      36
      ---
  122)257
      244
      -----
 1241)1330
      1241
      ------
124207)890000
       869449
       ------
        20551
```

If to the square of this root we add the remaining figures 20551, we shall have our given square, whose root was required.

What is the square root of 16007.3104?
Answer 126.52.

What is the square root of 348.17320836?
Answer 18.6594.

What is the square root of 12345678987654321?
Answer 111111111.

The application of this will hereafter be shewn.

THE

ELEMENTS

OF

PLANE GEOMETRY.

DEFINITIONS.

Plate I.

GEOMETRY is that science wherein we consider the properties of magnitude.

2. A point is that which has no parts, being of itself indivisible, as A.

3. A line has length but no breadth. as AB. figures 1 and 2.

4. The extremities of a line are points, as the extremities of the line AB are the points A and B. figures 1 and 2.

5. A right line is the shortest that can be drawn between any two points, as the line AB. fig. 1. but if it be not the shortest, it is then called a curve line, as AB. fig 2.

Plate I.

6. A superfices or surface is considered only as having length and breadth, without thickness, as ABCD. fig. 3.

7. The extremities of a superfices are lines.

8. The inclination of two lines meeting one another (provided they do not make one continued line) or the opening between them, is called an angle. Thus fig. 4. the inclination of the line AB to the line BC meeting each other in the point B, or the opening of the two lines BA and BC, is called an angle, as ABC.

Note, When an angle is expressed by three letters, the middle one is that at the angular point.

10. When the lines that form the angle are right ones, it is then called a right-lined angle, as ABC. fig. 4. If one of them be right and the other curved, it is called a mix'd-angle, as B. fig. 5. If both of them be curved it is called a curved-lined or a spherical angle, as C. fig. 6.

11. If a right line, CD (fig. 7) fall upon another right line, AB, so as to incline to neither side but make the angles ADC, CDB, on each side equal to each other, then those angles are called right angles, and the line CD a perpendicular.

12. An obtuse angle is that which is wider or greater than a right one, as the angle ADE. fig. 7. and an acute angle is less than a right one, as EDB. fig. 7.

Plate I.

13. Acute and obtuse angles in general are called oblique angles.

14. If a right line CB. (fig. 8.) be fastened at the end C, and the other end B, be carried quite round, then the space comprehended is called a circle; and the curve line described by the point B, is called the circumference, or the periphery of the circle; the fixed point C is called its centre.

15. The describing line CB. (fig. 8.) is called the semidiameter, or radius, or any line from the centre to the circumference: whence all radii of the same or of equal circles are equal.

16. The diameter of a circle is a right line drawn thro' the centre, and terminating on either side of the circumference; and it divides the circle and circumference into two equal parts called semicircles; and is double the radius, as AB or DE. fig. 8.

18. The circumference of every circle is supposed to be divided into 360 equal parts called degrees, and each degree into 60 equal parts called minutes, and each minute into 60 equal parts called seconds, and these into thirds, fourths, &c. these parts being greater or less as the radius is.

19. A chord is a right line drawn from one end of an arc or arch (that is, any part of the circumference of a circle) to the other; and is the measure of the arc. Thus the right line HG, is the measure of the arc HBG. fig. 8.

20. The segment of a circle is any part thereof, which is cut off by a chord: thus the space which is comprehended between the chord HG

Plate I.

and the arc HBG, or that which is comprehended between the said chord HG and the arc HDAEG are called segments. Whence it is plain, fig. 8.

1. That any chord will divide the circle into two segments.

2. The less the chord is, the more unequal are the segments.

3. When the chord is greatest it becomes a diameter, and then the segments are equal; and each segment is a semicircle.

21. A sector of a circle is a part thereof less than a semicircle, which is contained between two radii and an arc: thus the space contained between the two radii CH, CB, and the arc HB is a sector. fig. 8.

22. The right sine of an arc, is a perpendicular line let fall from one end thereof, to a diameter drawn to the other end: thus HL is the right sine of the arc HB.

The sines on the same diameter increase till they come to the centre, and so become the radius: hence it is plain that the radius CD is the greatest possible sine, and thence is called the whole sine.

Since the whole sine CD (fig. 8.) must be perpendicular to the diameter (by def. 22.) therefore producing DC to E the two diameters AB and DE cross one another at right angles, and thus the periphery

Plate I.

periphery is divided into four equal parts, as BD, DA, AE, and EB; (by def. 11.) and so BD becomes a quadrant or the fourth part of the periphery; therefore the radius DC is always the sine of a quadrant, or of the fourth part of the circle BD.

Sines are said to be of as many degrees as the arc contains parts of 360: so the radius being the sine of a quadrant, becomes the sine of 90 degrees, or the fourth part of the circle, which is 360 degrees.

23. The versed sine of an arc is that part of the diameter that lies between the right sine and the circumference: thus LB is the versed sine of the arc HB. fig. 8.

24. The tangent of an arc is a right line touching the periphery, being perpendicular to the end of the diameter, and is terminated by a line drawn from the centre thro' the other end: thus BK is the tangent of the arc HB. fig. 8.

25. And the line which terminates the tangent, that is CK, is called the secant of the arc HB. fig. 8.

26. What an arc wants of a quadrant is called the complement thereof: thus DH is the complement of the arc HB.

27. And what an arc wants of a semicircle is called the supplement thereof: thus AH is the supplement of the arc HB. fig. 8.

28. The

Plate I.

28. The sine, tangent, or secant of the complement of any arc, is called the co-sine, co-tangent, or co-secant of the arc itself: thus FH is the sine, DI the tangent, and CI the secant of the arc DH; or they are the co-sine, co-tangent, or co-secant of the arc HB. fig. 8.

29. The sine of the supplement of an arc, is the same with the sine of the arc itself; for drawing them according to def. 22, there results the self same line; thus HL is the sine of the arc HB, or of its supplement ADH. fig. 8.

30. The measure of a right-lined angle, is the arc of a circle swept from the angular point, and contained between the two lines that form the angle: thus the angle HCB (fig. 8.) is measured by the arc HB, and is said to contain so many degrees as the arc HB does; so if the arc HB is 60 degrees, the angle HCB is an angle of 60 degrees.

Hence angles are greater or less according as the arc described about the angular point, and terminated by the two legs, contain a greater or less number of degrees of the whole circle.

31. The sine, tangent, and secant of an arc, is also the sine, tangent, and secant of an angle whose measure the arc is: thus because the arc HB is the measure of the angle HCB, and since HL is the sine, BK the tangent, and CK the secant, BL the versed sine, HF the co-sine, DI the co-tangent, and CI the co-secant, &c. of the arc BH; then HL is called the sine, BK the tangent,

Plate I.

tangent, CK the secant, &c. of the angle HCB, whose measure is the arc HB. fig. 8.

32. Parallel lines are such as are equidistant from each other, as AB, CD. fig. 9.

33. A figure is a space bounded by a line or lines. If the lines be right it is called a rectilineal figure, if curved it is called a curvilineal figure; but if they be partly right and partly curved lines, it is called a mixt figure.

34. The most simple rectilineal figure is a triangle, being composed of three right lines, and is considered in a double capacity; 1st, with respect to its sides; and 2d, to its angles.

35. In respect to its sides it is either equilateral, having the three sides equal, as A. fig. 10.

36. Or isosceles, having two equal sides, as B. fig. 11.

37. Or scalene, having the three sides unequal, as C. fig. 12.

38. In respect to its angles, it is either right-angled, having one right angle, as D. fig. 13.

39. Or obtuse angled, having one obtuse angle, as E. fig. 14.

40. Or acute angled, having all the angles acute, as F. fig. 15.

Plate I.

41. Acute and obtuse angled triangles are in general called oblique angled triangles, in all which any side may be called the base, and the other two the sides.

42. The perpendicular height of a triangle is a line drawn from the vertex to the base perpendicularly: thus if the triangle ABC, be proposed, and BC be made its base, then if from the vertex A the perpendicular AD be drawn to BC, the line AD will be the height of the triangle ABC, standing on BC as its base, fig. 16.

Hence all triangles between the same parallels have the same height, since all the perpendiculars are equal from the nature of parallels.

43. Any figure of four sides is called a quadrilateral figure.

44. Quadrilateral figures whose opposite sides are parallel, are called parallelograms: thus ABCD is a parallelogram. fig. 3. 17. and AB. fig. 18. and 19.

45. A parallelogram whose sides are all equal and angles right, is called a square, as ABCD. fig. 17.

46. A parallelogram whose opposite sides are equal and angles right, is called a rectangle or an oblong, as ABCD, fig. 3.

47. A rhombus is a parallelogram of equal sides, and has its angles oblique, as A. fig. 18. and is an inclined square.

48. A

Plate I.

48. A rhomboides is a parallelogram whose opposite sides are equal and angles oblique; as B. fig. 19. and may be conceived as an inclined rectangle.

49. Any quadrilateral figure that is not a parallelogram, is called a trapezium. Plate 7. fig. 3.

50. Figures which consist of more than four sides are called polygons; if the sides are all equal to each other, they are called regular polygons. They sometimes are named from the number of their sides, as a five-sided figure is called a pentagon, one of six sides a hexagon, &c. but if their sides are not equal to each other, then they are called irregular polygons, as an irregular pentagon, hexagon, &c.

51. Four quantities are said to be in proportion when the product of the extremes is equal to that of the means: thus if A multiplied by D, be equal to B multiplied by C, then A is said to be to B as C is to D.

POSTULATES OR PETITIONS.

1. That a right line may be drawn from any one given point to another.

2. That a right line may be produced or continued at pleasure.

3. That from any centre and with any radius, the circumference of a circle may be described.

4. It is also required that the equality of lines and angles to others given, be granted as possible:

that it is possible for one right line to be perpendicular to another, at a given point or distance; and that every magnitude has its half, third, fourth, &c. part.

Note. Though these postulates are not always quoted, the reader will easily perceive where, and in what sense they are to be understood.

AXIOMS or self-evident TRUTHS.

1. Things that are equal to one and the same thing, are equal to each other.

2. Every whole is greater than its part.

3. Every whole is equal to all its parts taken together.

4. If to equal things, equal things be added, the wholes will be equal.

5. If from equal things, equal things be deducted, the remainders will be equal.

6. If to or from unequal things, equal things be added or taken, the sums or remainders will be unequal.

7. All right angles are equal to one another.

8. If two right lines not parallel, be produced towards their nearest distance, they will intersect each other.

9. Things which mutually agree with each other, are equal.

NOTES.

A theorem is a propoſition, wherein ſomething is propoſed to be demonſtrated.

A problem is a propoſition, wherein ſomething is to be done or effected.

A lemma is ſome demonſtration, previous and neceſſary, to render what follows the more eaſy.

A corollary is a conſequent truth, deduced from a foregoing demonſtration.

A ſcholium, is a remark or obſervation made upon ſomething going before.

The Signification of SIGNS.

The ſign =, denotes the quantities between which it ſtands to be equal.

The ſign +, denotes the quantity it precedes to be added.

The ſign −, denotes the quantity which it precedes to be ſubtracted.

The ſign ×, denotes the quantities between them to be multiplied into each other.

To denote that four quantities, A, B, C, D, are proportional, they are uſually written thus. A : B : : C : D ; and read thus, as A is to B, ſo is C to D ; but when three quantities A, B, C, are proportional, the middle quantity is repeated, and they are written A : B : : B : C.

GEOMETRIAL

THEOREMS.

THEOREM I.

Plate I.

IF a right line falls on another, as A B, or E B, does on C D, (fig. 20.) it either makes with it two right angles, or two angles equal to two right angles.

1. If AB be perpendicular to CD, then (by def. 11.) the angles CBA, and ABD, will be each a right angle.

2. But if EB fall slantwise on CD, then are the angles DBE + EBC = DBE + EBA (=DBA) + ABC, or to two right angles. Q. E. D.

Corollary 1. Whence if any number of right lines were drawn from one point, on the same side of a right line; all the angles made by these lines will be equal to two right angles.

2. And all the angles which can be made about a point, will be equal to four right angles.

THEO-

THEO. II.

Plate I.

If one right line cross another (as AC does BD) the opposite angles made by those lines, will be equal to each other: that is, AEB to CED and BEC to AED. fig. 21.

By theorem 1. BEC + CED = 2 right angles.
and CED + DEA = 2 right angles.

Therefore (by axiom 1.) BEC+CED=CED+DEA: take CED from both and there remains BEC = DEA. (by axiom 5.) Q. E. D.

After the same manner CED + AED = 2 right angles; and AED+AEB=2 right angles; wherefore taking AED from both, there remains CED =AEB. Q. E. D.

THEO. III.

If a right line cross two parallels, as GH does AB and CD. (fig. 22.*) then,*

1. *Their external angles are equal to each other, that is, GEB = CFH.*

2. *The alternate angles will be equal, that is, AEF =EFD and BEF=CFE.*

3. *The external angle will be equal to the internal and opposite one on the same side, that is, GEB=EFD and AEG=CFE.*

4. *And*

Plate I.

4. *And the sum of the internal angles on the same side, are equal to two right angles; that is, BEF+DFE are equal to two right angles, and AEF+CFE are equal to two right angles.*

1. Since AB is parallel to CD, they may be considered as one broad line, crossed by another line, as GH; (then by the last theo.) GEB=CFH, and AEG=HFD.

2. Also GEB=AEF, and CFH=EFD; but GEB = CFH (by part 1. of this theo.) therefore AEF = EFD. The same way we prove FEB= EFC.

3. AEF=EFD; (by the last part of this theo.) but AEF = GEB (by theo. 2.) Therefore GEB= EFD. The same way we prove AEG=CFE

4. For since GEB = EFD, to both add FEB, then (by axiom 4.) GEB+FEB=EFD+FEB, but GEB + FEB, are equal to two right angles (by theo. 1.) Therefore EFD + FEB are equal to two right angles: after the same manner we prove that AEF + CFE are equal to two right angles, Q. E. D.

THEO. IV.

In any triangle ABC, one of its legs, as BC, being produced towards D, it will make the external angle ACD equal to the two internal opposite angles taken together. Viz. to B and A. fig. 23.

Thro' C, let CE be drawn parallel to AB; then since BD cuts the two parallel lines BA, CE; the angle ECD = B (by part 3. of the last theo.) and again, since AC cuts the same parallels, the angle ACE = A (by part 2. of the last,) Therefore ECD + ACE = ACD = B + A. Q. E. D.

THEO. V.

In any triangle ABC, all the three angles taken together are equal to two right angles, viz. A + B + ACB = 2 right angles. fig. 23.

Produce BC to any distance, as D, then (by the last) ACD=B+A; to both add ACB; then ACD + ACB = A + B + ACB; but ACD + ACB = 2 right angles (by theo. 1.) therefore the three angles A+B+ACB=2 right angles. Q. E. D.

Cor. 1. Hence if one angle of a triangle be known, the sum of the other two is also known: for since the three angles of every triangle contain two right ones, or 180 degrees, therefore 180 —the given angle will be equal to the sum of the other two; or 180—the sum of two given angles, gives the other one.

Cor. 2. In every right-angled triangle, the two acute angles are =90 degrees, or to one right-angle: therefore 90—one acute angle, gives the other.

THEO.

Plate I.

THEO. VI.

If in any two triangles, ABC, DEF, there be two sides, AB, AC in the one, severally equal to DE, DF in the other, and the angle A contained between the two sides in the one, equal to D in the other; then the remaining angles of the one, will be severally equal to those of the other, viz. B = E and C = F: and the base of the one BC, will be equal to EF, that of the other. fig. 24.

If the triangle ABC be supposed to be laid on the triangle DEF, so as to make the points A and B coincide with D and E, which they will do, because AB = DE (by the hypothesis); and since the angle A = D, the line AC will fall along DF, and inasmuch as they are supposed equal, C will fall in F; seeing therefore the three points of one coincide with those of the other triangle, they are manifestly equal to each other; therefore the angle B=E and C=F, and BC=EF. Q. E. D.

LEMMA.

If two sides of a triangle a b c be equal to each other that is, ac=cb; the angles which are opposite to those equal sides, will also be equal to each other; viz. a=b. fig. 11.

For let the triangle a b c be divided into two triangles a c d, d c b, by making the angle a c d= d c b (by postulate 4.) then because a c =b c, and c d common (by the last) the triangle a d c=d c b; and therefore the angle a=b. Q. E. D.

Cor.

Plate I.

Cor. Hence if from any point in a perpendicular which bisects a given line, there be drawn right lines to the extremities of the given one, they with it will form an isosceles triangle.

THEO. VII.

The angle BCD at the centre of a circle ABED, is double the angle BAD at the circumference, standing upon the same arc BED. fig. 25.

Through the point A, and the centre C, draw the line ACE: then the angle ECD = CAD + CDA; (by theo. 4.) but since AC = CD being radii of the same circle, it is plain (by the preceding lemma) that the angles subtended by them will be also equal, and that their sum is double to either of them, that is, DAC + ADC is double to CAD, and therefore ECD is double to CAD; after the same manner BCE is double to CAB, wherefore, BCE + ECD, or BCD is double to BAC+CAD or to BAD. Q. E. D.

Cor. 1. Hence an angle at the circumference is measured by half the arc it subtends or stands on.

Cor. 2. Hence all angles at the circumference of a circle which stand on the same chord as AB, are equal to each other, for they are all measured by half the arc they stand on, *viz.* by half the arc AB. fig. 26.

Cor.

Plate I.

Cor. 3. Hence an angle in a segment greater than a semicircle is less than a right angle; thus ADB is measured by half the arc AB, but as the arc AB is less than a semicircle, therefore half the arc AB, or the angle ADB is less than half a semicircle, and consequently less than a right angle. fig. 26.

Cor. 4. An angle in a segment less than a semicircle, is greater than a right angle, for since the arc AEC is greater than a semicircle, its half, which is the measure of the angle ABC, must be greater than half a semicircle, that is, greater than a right angle. fig. 27.

Cor. 5. An angle in a semicircle is a right angle, for the measure of the angle ABD, is half of a semicircle AED, and therefore a right angle. fig. 28.

THEO. VIII.

If from the centre C of a circle ABE, there be let fall the perpendicular CD on the chord AB, it will bisect it in the point D. fig. 29.

Let the lines CA and CB be drawn from the centre to the extremities of the chord, then since CA=CB, the angle CAB=CBA (by the lemma.) But the triangles ADC, BDC are right angled ones, since the line CD is a perpendicular; and so the angle ACD=DCB; (by cor. 2. theo. 5.) then have we AC, CD, and the angle ACD in one triangle; severally equal to CB, CD, and the angle BCD in the other: therefore (by theo. 6.) A=DB. Q. E. D.

So

Plate I.

Cor. Hence it follows, that any line bisecting a chord at right angles, is a diameter; for a line drawn from the centre perpendicular to a chord, bisects that chord at right angles; therefore, conversely, a line bisecting a chord at right angles must pass through the centre, and consequently be a diameter.

THEO. IX.

If from the centre of a circle ABE there be drawn a perpendicular CD on the chord AB, and produced till it meets the circle in F, that line CF, will bisect the arc AB in the point F. fig. 29.

Let the lines AF and BF be drawn, then in the triangles ADF, BDF: AD = BD (by the last;) DF is common, and the angle ADF = BDF being both right, for CD or DF is a perpendicular. Therefore (by theo. 6.) AF = FB; but in the same circle, equal lines are chords of equal arcs, since they measure them (by def. 19.) whence the arc AF = FB, and so AFB is bisected in F, by the line CF.

Cor. Hence the sine of an arc is half the chord of twice that arc. For AD is the sine of the arc AF (by def. 22.) AF is half the arc, and AD half the chord AB (by theo. 8.) therefore the cor. is plain.

THEO. X.

Plate I.

In any triangle ABD, the half of each side is the sine of the opposite angle. fig. 30.

Let the circle ADB be drawn thro' the points A, B, D; then the angle DAB is measured by half the arc BKD (by cor. 1. theo. 7.) *viz.* the chord of BK is the measure of the angle BAD; therefore (by cor. to the last) BE the half of BD is the sine of BAD: the same way may be proved, that half of AD is the sine of ABD, and the half of AB the sine of ADB. Q. E. D.

THEO. XI.

If a right line GH cut two other right lines AB, CD, so as to make the alternate angles AEF, EFD equal to each other, then the lines AB and CD will be parallel. fig. 22.

If it be denied that AB is parallel to CD, let IK be parallel to it; then IEF=(FED)=AEF (by part 2. theo. 3.) a greater to a less, which is absurd, whence IK is not parallel; and the like we can prove of all other lines but AB; therefore AB is parallel to CD. Q. E. D.

THEO. XII.

If two equal and parallel lines AB, CD, be joined by two other lines AD, BC, those shall be also equal and parallel. fig. 3.

Let

Plate I.

Let the diameter or diagonal BD be drawn, and we will have the two triangles ABD, CBD; whereof AB in one is = to CD in the other, DB common to both, and the angle ABD = CDB (by part 2. theo. 3.) therefore (by theo. 6.)AD=CB, and the angle CBD=ADB, and thence the lines AD and BC are parallel by the preceding theorem.

Cor. 1. Hence the quadrilateral figure ABCD is a parallelogram, and the diagonal BD biſects the same, in asmuch as the triangle ABD=BDC, as now proved.

Cor. 2. Hence also the triangle ADB on the same base AB, and between the same parallels with the parallelogram ABCD, is half the parallelogram.

Cor. 3. It is hence also plain, that the opposite sides of a parallelogram are equal; for it has been proved that ABCD being a parallelogram, AB will be=CD and AD=BC.

THEO. XIII.

All parallelograms on the same or equal bases and between the same parallels, are equal to one another, that is, if BD=GH, and the lines BH and AF parallel, then the parallelogram ABDC=BDFE=EFHG. fig. 31.

For AC=DB=EF (by cor. the last;) to both add CE, then AE=CF. In the triangles ABE, CDF: AB = CD and AE = CF and the angle BAE = DCF (by part 3. theo. 3.) therefore the triangle ABE = CDF. (by theo. 6.) let the triangle CKE be taken from both, and we will have

Plate I.

have the trapezium ABKC = KDFE; to each of these add the triangle BKD, then the parallelogram ABCD = BDEF; in like manner we may prove the parallelogram EFGH=BDEF. Wherefore ABDC=BDEF=EFHG. Q. E. D.

Cor. Hence it is plain that triangles on the same or equal bases and between the same parallels, are equal, seeing (by cor. 2. theo. 12.) they are the halves of their respective parallelograms.

THEO. XIV.

In every right-angled triangle, ABC, the square of the hypothenuse or longest side, BC, or BCMH, is equal to the sum of the squares made on the other two sides AB and AC, that is, to ABDE and ACGF, fig. 32.

Through A draw AKL perpendicular to the hypothenuse BC, join AH, AM, DC and BG; in the triangles BDC, ABH, BD = BA being sides of the same square, and also BC=BH, and the included angle DBC = ABH, (for DBA=CBH being both right, to both add ABC, then DBC = ABH) therefore the triangle DBC=ABH (by theo. 6.) but the triangle DBC is half of the square ABDE (by cor. 2. theo. 12.) and the triangle ABH is half the parallelogram BKLH (by the same;) therefore half the square ABDE is equal to half the parallelogram BKLH, and the square ABDE equal to the parallelogram BKLH. The same way it may be proved, that the square ACGF, is equal to the parallelogram KCLM. So ABDE + ACGF the sum of the squares, = BKLH+KCML, the sum of the two parallelograms or square BCMH; therefore the sum of the squares on AB and AC is equal to the square on BC. Q. E. D.

Cor. 1. Hence the hypothenuse of a right-angled triangle may be found by having the legs; thus, the square root of the sum of the squares of the base and perpendicular, will be the hypothenuse.

Cor. 2. Having the hypothenuse and one leg given to find the other; the square root of the difference of the squares of the hypothenuse and given leg, will be the required leg.

THEO. XV.

In all circles the chord of 60 *degrees is always equal in length to the radius.*

Thus in the circle AEBD, if the arc AEB be an arc of 60 *degrees, and the chord AB be drawn; then AB=CB=AC. fig.* 33.

In the triangle ABC, the angle ACB is 60 degrees, being measured by the arc AEB; therefore the sum of the other two angles is 120 degrees (by cor. 1. theo. 5.) but since AC=CB, the angle CAB=CBA (by lemma preceding theo. 7.) consequently each of them will be 60, the half of 120 degrees, and the three angles will be equal to one another, as well the three sides: wherefore AB=BC=AC. Q. E. D.

Plate I.

Cor. Hence the radius, from whence the lines on any scale are formed, is the chord of 60 degrees on the line of chords.

THEO. XVI.

If in two triangles ABC, abc, all the angles of one, be each respectively equal to all the angles of the other, that is, A = a, B = b, C = c: then the legs opposite to the equal angles will proportional, viz.

AB : ab : : AC : ac *Fig. 34.*
AB : ab : : BC : bc
and AC : ac : : BC : bc

For the triangles being inscribed in two circles, it is plain since the angle A = a, the arc BDC = b d c, and consequently the chord BC is to b c, as the radius of the circle ABC is to the radius of the circle a b c; (for the greater the radius is, the greater is the circle described by that radius; and consequently the greater any particular arc of that circle is, so the chord, sine, tangent, *&c.* of that arc will be also greater. Therefore, in general, the chord, sine, tangent, *&c.* of any arc is proportional to the radius of the circle) the same way the chord AB is to the chord a b, in the same proportion. So AB : ab : : BC : bc : the same way the rest may be proved to be proportional.

THEO. XVII.

If from a point A without a circle DBCE there be drawn two lines ADE, ABC, each of them cutting the circle in two points; the product of one whole

Plate I.

whole line into its external part, viz, AC into AB, will be equal to that of the other line into its external part, viz, AE into AD. fig. 35.

Let the lines DC, BE be drawn in the two triangles ABE, ADC; the angle AEB = ACD (by cor. 2. theo. 7.) the angle A is common, and (by cor. 1. theo. 5.) the angle ADC=ABE; therefore the triangles ABE, ADC, are mutually equi-angular and consequently (by the last) AC : AE : : AD : AB; wherefore AC multiplied by AB, will be equal to AE multiplied by AD. Q. E. D.

THEO. XVIII.

Plate II. fig. 1.

Triangles ABC, BCD, and parallelograms ABCF, and BDEC, having the same altitude, have the same proportion between themselves as their bases AB and BD.

Let any aliquot part of AB be taken, which will also measure BD: suppose that to be Ag, which will be contained twice in AB, and three times in BD, the parts Ag, gB, Bh, hi, and iD being all equal, and let the lines gC, hC, and iC, be drawn: then (by cor. to theo. 13.) all the small triangles AgC, gCB, BCh. &c. will be equal to each other; and will be as many as the parts into which their bases were divided: therefore it will be as the sum of the parts in one base, is to the sum of those in the other, so will be the sum of the small triangles in the first, to the sum of the small triangles in the second triangle; that is, AB : BD : : ABC : BDC.

Whence

Plate II.

Whence also the parallelograms ABCF and BDEC, being (by cor. 2. theo. 12.) the doubles of the triangles, are likewise as their bases. Q. E. D.

Note. Wherever there are several quantities connected with the sign : : the conclusion is always drawn from the first two and last two proportionals.

THEO. XIX.

Triangles ABC, DEF, standing upon equal bases AB and DE, are to each other as their altitudes CG and FH. fig. 2.

Let BI be perpendicular to AB and equal to CG, in which let KB = FH, and let AI and AK be drawn.

The triangle AIB=ACB (by cor. to theo. 13.) and AKB=DEF; but (by theo. 18.) BI : BK : : ABI : ABK. That is, CG : FH : : ABC : DEF. Q. E. D.

THEO. XX.

If a right line BE be drawn parallel to one side of a triangle ACD, it will cut the two other sides proportionally, viz. AB : BC : : AE : ED. fig. 3.

Draw CE and BD; the triangles BEC and EBD being on the same base BE and under the same parallel CD, will be equal (by cor. to theo. 13.) therefore (by theo. 18.) AB : BC : : (BEA : BEC or BEA : BED) : : AE : ED. Q. E. D.

Cor.

Plate II.

Cor. 1. Hence also AC : AB : : AD : AE : For AC : AB : : (AEC : AEB : : ABD : AEB) : : AD : AE.

Cor. 2. It also appears that a right line, which divides two sides of a triangle proportionally must be parallel to the remaining side.

Cor. 3. Hence also theo. 16. is manifest; since the sides of the triangles ABE, ACD, being equiangular, are proportional.

THEO. XXI.

If two triangles ABC, ADE, have one angle BAC, in one, equal to one angle DAE, in the other, and the sides about the equal angles, proportional, that is, AB : AD : : AC : AE, then the triangles will be mutually equiangular. fig. 4.

In AB take Ad=AD, and let d e be parallel to BC, meeting AC in e.

Because (by the first cor. to the foregoing theo.) AB : Ad : : (AD) AC : Ae, and (by the hypothesis, or what is given in the theorem) AB : AD : AC : AE; therefore Ae = AE seeing AC bears the same proportion to each; and (by theo. 6.) the triangle A d c = ADE, therefore the angle Ade=D and Aed=E, but since ed and BC are parallel (by part 3. theo. 3.) Ade=B, and Aed= C, therefore B=D and C=E. Q. E. D.

Plate II.

THEO. XXII.

Equiangular triangles ABC, DEF, are to one another in a duplicate proportion of their homologous or like sides; or as the squares AK, and DM of their homologous sides, fig. 5.

Let the perpendiculars CG and FH be drawn, as well as diagonals BI and EL.

The perpendiculars make the triangles ACG and DFH equiangular, and therefore similar (by theo. 16.) for because the angle CAG = FDH and the right angle AGC=DHF, the remaining angle ACG=DFH, (by cor. 2 theo. 5.)

Therefore GC : FH : : (AC : DF : :) AB : DE, or which is the same thing, GC : AB : : FH : DE for FH multiplied by AB=AB multiplied by FH.

By theo. 19. ABC : ABI : : (CG : AI or AB as before : : FH DE or DL : :) DFE : : DLE, therefore ABC : ABI : : DFE : DLE or ABC : AK : : DFE : DM, for AK is double the triangle ABI, and DM double the triangle DEF, by cor. 2. theo. 12. Q. E. D.

THEO. XXIII.

Like polygons ABCDE, a b c d e, are in a duplicate proportion to that of the sides AB, a b, which are between the equal angles A and B, and a and b, or as the squares of the sides AB, ab, fig. 6.

Draw AD, AC, ad, ac.

By

Plate II.

By the hypothesis AB : ab : : BC : bc, and thereby also the angle B=b; therefore (by theo. 21.) BAC = b a c; and ACB = a c b; in like manner EAD=e a d, and EDA=e d a. If therefore from the equal angles A, and a, we take the equal ones EAD + BAC = e a d + b a c the remaining angle DAC=d a c, and if from the equal angles D and d, EDA=e d a be taken, we shall have ADC=a d c: and in like manner if from C and c be taken BCA=b c a, we shall have ACD=a c d; and so the respective angles in every triangle, will be equal to those in the other.

By theo. 22. ADC : a b c : : the square of AC to the square of ac, and also ADC : adc : : the square of AC, to the square of a c; therefore from equality of proportions ABC : a b c : : ADC : a d c, in like manner we may shew that ADC : a d c : EAD : e a d: Therefore it will be as one antecedent is to one consequent, so are all the antecedents to all the consequents. That is, ABC : a b c as the sum of the three triangles in the first polygon, is to the sum of those in the last. Or ABC will be to a b c, as polygon to polygon.

The proportion of ABC to a b c (by the foregoing theo.) is as the square of AB is to the square of ab, but the proportion of polygon to polygon, is as ABC to a b c, as now shewn: therefore the proportion of polygon to polygon is as the square of AB to the square of a b.

THEO.

Plate II.

THEO. XXIV.

Let DHB be a quadrant of a circle described by the radius CB; HB an arc of it, and DH its complement; HL or FC the sine, FH or CL its co-sine; BK its tangent, DI its co-tangent; CK its secant, and CI its co-secant. fig. 8.

1. The co-sine of an arc is to the sine, as radius is to the tangent.

2. Radius is to the tangent of an arc, as the co-sine of it is to the sine.

3. The sine of an arc is to its co-sine, as radius to its co-tangent.

4. Or radius is to the co-tangent of an arc, as its sine to its co-sine.

5. The co-tangent of an arc is to radius, as radius to the tangent.

6. The cosine of an arc is to radius, as radius is to the secant.

7. The sine of an arc is to radius, as the tangent is to the secant.

The triangles CLH and CBK, being similar, (by theo. 16.)

1. CL : LH : : CB : BK.

2. Or, CB : BK : : CL : LH.

The

Plate II.

The triangles CFH and CDI, being similar.

3. CF (or LH) : FH : : CD : DI.

4. CD : DI : : CF (or LH) : FH.

The triangles CDI and CBK are similar: for the angle CIB = KCB, being alternate ones (by part 2. theo. 3.) the lines CB and DI being parallel: the angle CDI=CBK being both right, and consequently the angle DCI=CKB, wherefore,

5. DI : CD : : CB : BK.

And again, making use of the similar triangles CLH and CBK,

6. CL : CB : : CH : CK.

7. HL : CH : BK : CK.

GEOMETRICAL PROBLEMS.

PROBLEM I.

Plate II.

TO make a triangle of three given right lines BO, LB, LO, of which any two must be greater than the third. fig. 7.

Lay BL from B to L; from B with the line BO, describe an arc, and from L with LO describe another arc; from O, the interjection point of those arcs, draw BO and OL, and BOL is the triangle required.

This is manifest from the construction.

PROB. II

At a point B in a given right line BC, to make an angle equal to a given angle A. fig. 8.

Draw any right line ED to form a triangle, as EAD, take BF=AD, and upon BF make the triangle BFG, whose side BG = AE, and GF=ED (by the last) then also the angle B = A if we suppose one triangle be laid on the other, the sides will mutually agree with each other, and therefore be equal; for if we consider these two triangles are made of the same given three lines, they are manifestly one and the same triangle.

Otherwise,

Plate II.

Upon the centres A and B, at any distance, let two arcs, DE, FG, be described; make the arc FG=DE, and thro' B and G draw the line BG, and it is done.

For since the chords ED, GF, are equal, the angles A and B are also equal, as before (by def. 19.)

PROB. III.

To bisect or divide into two equal parts, any given right lined angle, BAC. fig. 9.

In the lines AB and AC, from the point A set off equal distances AE=AD, then, with any distance more than the half of DE, describe two arcs to cut each other in some point F; and the right-line AF, joining the points A and F, will bisect the given angle BAC.

For if DF and FE be drawn, the triangles ADF, AEF, are equilateral to each other, *viz.* AD =AE, DF = FE, and AF common, wherefore DAF=EAF, as before.

PROB. IV.

To bisect a right line, AB. fig. 10.

With any distance, more than half the line, from A and B, describe two circles CFD, CGD, cutting each other in the points C and D; draw CD, intersecting AB in E, then AE=EB.

For

Plate II.

For, if AC, AD, BC, BD, be drawn; the triangles ACD, BCD, will be mutually equilateral and consequently the angle ACE = BCE: therefore the triangle ACE, BCE, having AC = BC, CE common, and the angle ACE=BCE; (by theo. 6.) the base AE=the base BE.

Cor. Hence it is manifest, that CD not only biſects AB, but is perpendicular to it. (by def. 11.)

PROB. V.

On a given point A, in a right line EF, to erect a perpendicular. fig. 11.

From the point A lay off on each side, the equal distances, AC, AD; and from C and D, as centres, with any interval greater than AC or AD, describe two arcs interſecting each other in B; from A to B draw the line AB, and it will be the perpendicular required.

For let CB, and BD be drawn; then the triangles CAB, DAB, will be mutually equilateral and equiangular, so CAB=DAB, a right angle, (by def. 11.)

PROB. VI.

To raise a perpendicular on the end B of a right line AB. fig. 12.

From any point D not in the line AB, with the distance from D to B, let a circle be described cutting AB in E; draw from E thro' D the right line EDC, cutting the periphery in C, and join CB; and that is the perpendicular required.

Plate II.

EBC being a semicircle, the angle EBC will be a right angle (by cor. 5. theo. 7.)

PROB. VII.

From a given point A, to let fall a perpendicular upon a given right line BC. fig. 13.

From any point D, in the given line, take the distance to the given point A, and with it describe a circle AGE, make GE=AG, join the points A and E, by the line AFE, and AF will be the perpendicular required.

Let DA, DE, be drawn; the angles ADF=FDE, DA=DE being radii of the same circle, and DF, common; therefore (by theo. 6.) the angle DFA =DFE, and FA a perpendicular. (By def. 11.)

PROB. VIII.

Thro' a given point A, to draw a right line AB, parallel to a given right line CD. fig. 14.

From the point A, to any point, F, in the line CD, draw the line AF; with the interval FA, and one foot in F, describe the arc AE, and with the like interval and one foot in A, describe the arc BF, making BF=AE; thro' A and B draw the line AB, and it will be parallel to CD.

By prob. 2. The angle BAF=AFE, and by theo. 11. BA and CD are parallel.

Plate II.

PROB. IX.

Upon a given line AB to describe a square ABCD. plate I. *fig.* 17.

Make BC perpendicular and equal to AB; and from A and C, with the line AB, or BC, let two arcs, be described, cutting each other in D; from whence to A and C, let the lines AD, DC be drawn; so is ABCD the square required.

For all the sides are equal by construction; therefore the triangles ADC and BAC, are mutually equilateral and equiangular, and ABCD is an equilateral parallelogram, whose angles are right. For B being right, D is also right, and DAC, DCA, BAC, ACB, each half a right angle (by lemma preceding theo. 7. and cor. 2. theo. 5.) whence DAB and BCD will each be a right angle, and (by def. 44.) ABCD is a square.

SCHOLIUM.

By the same method a rectangle or oblong, may be described, the sides thereof being given.

PROB. X.

To divide a given right line AB, into any proposed number of equal parts. fig. 15.

Draw the infinite right line AP, making any angle with AB, also draw BQ parallel to AP, in each of which, let there be taken as many equal parts

Plate II.

parts AM, MN, &c. Bo, on, &c. as you would have AB divided into; then draw Mm, Nn, &c. intersecting AB in E, F, &c. and it is done.

For MN and m n, being equal and parallel, FN will be parallel to EN; and in the same manner, GO to FN (by theo. 12.) therefore AM, MN, NO, being all equal by construction, it is plain (from theo. 20.) that AE, EF, FG, &c, will likewise be equal.

PROB. XI.

To find a third proportional to two given right lines, A and B. fig. 16.

Draw two infinite blank lines CE, CD, anywise to make an angle. Lay the line A, from C to F; and the line B, from C to G; and draw the line FG; lay again the line A, from C to H; and thro' H draw HI parallel to FG (by prob. 8.) so is CI the third proportional required.

For by cor. 1. theo. 20. CG : CH : : CF : CI.

Or, B : A : : A : CI.

PROB. XII.

Three right lines, A, B, C, given to find a fourth proportional. fig. 17.

Having

Plate II.

Having made an angle DEF anywise, by two infinite blank right lines, ED, EF, as before; lay the line A, from E to G; the line B from E to I; and draw the line IG; lay the line C, from E to H and (by prob. 8.) draw HK parallel thereto, so will EK be the fourth proportional required.

For, by cor. 1 theo. 20. EG : EI : : EH : EK.

Or, A : B : : C : EK.

PROB. XIII.

Plate III.

Two right lines A and B, given to find a mean proportional. fig. 1.

Draw an infinite blank line, as AF, on which lay the line A, from A to B, and the line B, from B to C, on the point B, which is the joining of the lines A and B; erect a perpendicular BD (by prob. 5.) bisect AC in E (by prob. 4.) and describe the semicircle ADC; and from the point D, where its periphery cuts the perpendicular BD, draw the line BD, and that will be the mean proportional required.

For if the lines AD, DC, be drawn, the angle ADC is a right angle (by cor. 5, theo. 7.) being an angle in a semicircle.

The angles ABD, DBC, are right ones (by def. 11.) the line BD being a perpendicular; wherefore the triangles ABD, DBC, are similar, thus the angle ABD=DBC, being both right, the angle DAC is the complement of BDA to a right angle (by cor. 2. theo. 5.) and is therefore equal to BDC, the angle ADC being a right angle as before; consequently (by cor. 1. theo. 5.) the angle ADB= DCB, wherefore (by theo. 16.)

AB : BD : : BD : BC.
Or, A : BD : : BD : B.

PROB. XIV.

To divide a right line AB, in the point E, so that AE shall have the same proportion to EB, as two given lines C and D have. fig. 2.

Draw an infinite blank line, AF, to the extremity of the line AB, to make with it any angle : lay the line C, from A to C ; and D from C to D ; and join the points B and D, by the line BD ; thro' C, draw CE parallel to BD (by prob. 8.) so is E the point of division.

For, by cor. 1. theo. 20. AC : AD : : AE : AB.
Or, C : D : : AE : EB.

PROB. XV.

To describe a circle about a triangle ABC or (which is the same thing) thro' any three points, A, B, C, which are not situate in a right line. fig. 3.

By prob. 4. Bisect the line AC by the perpendicular DE, and also CB, by the perpendicular FG, the point of intersection H, of these perpendiculars, is the centre of the circle required, from which take the distance to any of the three points A, B, C, and describe the circle ABC, and it is done.

For

Plate III.

For, by cor. to theo. 8. The lines DE and FG, must each pass thro' the centre, therefore, their point of interſection, H, must be the centre.

SCHOLIUM.

By this method the centre of a circle may be found by having only a segment of it given.

PROB. XVI.

To make an angle of any number of degrees, at the point A, of the line AB, suppose of 45 degrees. fig. 4.

From a scale of chords take 60 degrees, for 60 is equal to the radius (by cor. theo. 15.) and with that distance from A, as a centre, describe a circle from the line AB; take 45 degrees the quantity of the given angle, from the same scale of chords, and lay it on that circle from a to b, thro' A and b, draw the line AbC; and the angle A, will be an angle of 45 degrees, as required.

If the given angle were more than 90, take its half (or divide it into any two parts less than 90) and lay them after each other on the arc which is described with the chord of 60 degrees; thro' the extremity of which, and the centre, let a line be drawn, and that will form the angle required, with the given line.

PROB.

Plate III.

PROB. XVII.

To measure a given angle ABC. fig. 5.

If the lines which include the angle, be not as long as the chord of 60 on your scale, produce them to that or a greater length, and between them so produced, with the chord of 60 from B, describe the arc e d, which distance e d, measured on the same line of chords, gives the quantity of the angle BAC 48 degrees, as required; this is plain from def. 19.

PROB. XVIII.

To make a triangle BCE equal to a given quadrilateral figure ABCD. fig. 6.

Draw the diagonal AC, and parallel to it (by prob. 8.) DE, meeting AB produced in E; then draw CE, and ECB will be the triangle required.

For the triangles ADC, AEC, being upon the same base AC, and under the same parallel ED (by cor. to theo. 13.) will be equal, therefore if ABC be added to each, then ABCD=BEC.

PROB. XIX.

To make a triangle DFH, equal to a given five-sided figure ABCDE. fig. 7.

Draw DA and DB, and also EH and CF, parallel to them (by prob. 8.) meeting AB produced in H and

H and F; then draw DH, DF, and the triangle HDF is the one required.

For the triangle DEA = DHA, and DBC = DFB (by cor. to theo. 13.) therefore by adding these equations, DEA + DBC = DHA + DFB if to each of these ADB be added; then DEA+ADB+DBC=ABCDE=(DHA+ABD+DFB)=DHF.

PROB. XX.

To project the lines of chords, sines, tangents, and secants, to any radius. fig. 8.

On the line AB, let a semicircle ADB be described; let CD be drawn perpendicular to the centre C, and the tangent BE perpendicular to the end of the diameter; let the quadrants AD, DB, be each divided into 9 equal parts, every of which will be 10 degrees; if then from the centre C, lines be drawn thro' 10, 20, 30, 40, *&c.* the divisions of the quadrant BD, and continued to BF, we shall there have the tangents of 10, 20, 30, 40, *&c.* and the secants C 10, C 20, C 30, *&c.* are transferred to the line CD, produced by describing the arcs, 10, 10: 20, 20: 30, 30, *&c.* If from 10, 20, 30, *&c.* the divisions of the quadrant BD, there be let fall perpendiculars, let these be transferred to the radius CD, and we shall have the sines of 10, 20, 30, *&c.* and if from A we describe the arcs 10, 10: 20, 20: 30, 30, *&c.* from every division of the arc AD; we shall have a line of chords. The same way we may have the sine, tangent, *&c.* to every single degree on the quadrant, by subdividing every of the 9 former divisions into 10 equal parts. By this method the signs, tangents, &c. may be drawn to any radius; and if after, they be transferred to lines on a rule, we shall have the scales of signs, tangents, &c. ready for use.

Concerning Scales of equal Parts.

If an inch be divided into any assigned number of equal parts, and if these parts be continued on in a right line, and if the last of them be subdivided into 10 equal parts, and thence if the first divisions be numbered with 1, 2, 3, 4, &c. as far as the ruler upon which they are transferred will admit, the scale is completed.

These numbers, 1, 2, 3, 4, &c. usually stand for 10, 20, 30, 40, &c. and every one of the subdivisions is called 1; but if the numbers 1, 2, 3, 4, &c. be called 100, 200, 300, 400, &c. then every one of the subdivisions will be 10, and the units must be guessed at.

On one side of most surveying scales, there are lines or scales, marked at the end with 50, 45, 40, 35, 30, 25, 15, 10, and sometimes with other numbers; these are scales of so many parts to an inch (whether of feet, yards, perches, or miles) as the respective number at the end of each expresses; but in the surveying way, they are counted to be so many perches to an inch, and sometimes so many feet to an inch.

On the contrary side there are two scales, one of 10, and the other of 20; or one of 100, and the other of 200; or one of 1000, and the other of 2000 parts to an inch, diagonally divided; (a view of the scale will make all easy:) the first of these surveyors call a scale of 10, and the other a scale of 20 perches to an inch; and are thus counted: every large division is 10, every one of the subdivisions is 1, and every one downwards is one tenth of a perch; or sometimes thus, every large division is called 100, every subdivision 10, and every one downwards 1: or again, frequently by navigators, every large division is called 1000, every subdivision 100, every one downwards, 10, and the tenth part of the distance between the lines 1.

Hence it is easy to measure the length of any line knowing the scale by which it was laid down; and on the contrary, to set off any given distance from any scale.

OF

LOGARITHMS.

IF to a series of numbers in geometrical progression, whose common ratio is 10, and first term 1, we annex another series of numbers in arithmetical progression, whose first term is 0, and common difference 1; these latter numbers will be the logarithms of the former.

Numbers.	Logarithms.
1	0.00000
10	1.00000
100	2.00000
1000	3.00000
10000	4.00000, &c.

If several geometrical means be taken, and the like number of arithmetical ones, to the corresponding numbers, the latter will be the logarithms of the former.

The nature therefore of logarithms is such, that addition of them answers to the multiplication of their corresponding numbers; and subtraction to division; that is, when two numbers proposed are to be multiplied into each other, if we take the logarithms answering to those numbers, and add them together, the sum will be the logarithm answering to the number, which is the product of the two proposed numbers.

Again, when one number is proposed to be divided by another; if from the logarithm of the dividend, we subtract the logarithm of the divisor, the remainder shall be the logarithm of the quotient.

Most tables of logarithms contain the logarithms of all numbers from 1 to 10000, the column marked at the top N, is that in which you must find your number; in the same line with which in the adjacent column, is the logarithm of that number.

EXAMPLE.

Required, the logarithm of 365.

Answer, 2.56229.

And though most tables of logarithms run but to 10000, yet by them the log. of any number not exceeding 10,000,000 may be found, and on the contrary, the number to any such logarithm, thus,

1. Find the log. of the first four figures of the given number.

2. Take that log. from the log. of the number next following, and note their difference.

3. Multiply that difference by the remaining figures of the given number; and from the product cut off as many figures as remain in the given number, or as the given number is more than four (counting from the right to the left) as in decimals.

4. The whole number in the product, added to the first log. is the log. required; but the first figure, which is called the index, or characteristic must be changed; and always be one less than the number of figures in the logarithm.

EXAMPLE I.

Required, the logarithm of the number 3567894

The log. of 3567, which are the first four figures, is - - - 3.55230

The log. of the following or next number, *viz.* 3568, is - - - 3.55242

Their difference, - - - 12
Mult. by the remaining fig. *viz.* - .894

Cut off 3 figures, because 894 is three figures, and the product is - - 10.728
To which add the first log. 3.55230

Their sum is 3.55240

But because the given number consists of 7 figures, the index must be one less, which is 6; so the above index, 3, must be changed to 6, and we have 6.55240 the log. of 3567894 required.

EXAMPLE II.

Required, the log. of the number 125607.
The log. of 1256 is - - 3.09899
The next log. following is - 3.09934

Their

Their difference is - - -	35
Multiply by .07 the remaining figures	.07
Product - - - -	2.45
To which add the first log. -	3.09899
Their sum is - -	3.09901

Because the given number consists of 6 places, change the last index to 5, which is one less than the places in the given number; and you have 5.09901, the log. of 125607 required.

Because any number consisting of both integers and decimals, is equal to the quotient of the whole considered as an integer, divided by the denominator of the decimal part; and since by the nature of logarithms, subtraction in them answers the quotient of other numbers; therefore, it follows, that when a number is given, consisting of integers and decimals, we can find its log. thus: find the log. of the whole considered as one integer; then from that, take the log. of the denominator of the decimal part; or (which is the same thing) from the index of the log. of the whole considered as an integer, subtract a number less by one, than the number of places in the denominator of the fraction, and the remainder will be the log. required; or the index of the log. must be 1 less than the number of figures in the integer to which the decimal is annexed.

EXAMPLE I.

What is the log. of the number 36.5?

Find the log. of 365, which is 2.56229: then because 10 is the denominator of the decimal part of the proposed number, and 1,00000 its log. therefore, from 2.56229, take 1.00000, and there remains 1.56229 the log. required.

Or, because the whole number consists of two figures, the index of the lóg. must be one less, and is therefore 1.56229, as before.

EXAMPLE II.

What are the logs. of 6543, 654.3, 65.43, 6.543, .6543, .06543 and .006543?

6543	3.81578
654.3	2.81578
65.43	1.81578
6.543	0.81578
.6543	$\overline{9}.81578$
.06543	$\overline{8}.81578$
.006543	$\overline{7}.81578$

For the log. of a decimal fraction is the same as that of an integer; only the index is negative, and is so much less than 0. as the place of the decimal is removed from unity; and those indices may be distinguished from absolute ones, by setting a negative sign over them, as above.

To find the Number of a given Logarithm.

Look for the given log. amongst the logs. from 1000 to 10000 (not regarding the index or first figure) and if you find the exact log. you want, you have in the margin the required number. But if the index of the given log. be less than 3, cut off from the number found, as many figures as it is less; and the figures so cut off will be decimals, and the others integers. Or if the first figure or index, be greater than 3, add as many cyphers to the number found as it is more, and you have the number required.

EXAM-

EXAMPLES.

Find the numbers correspondent to the following logarithms.

Given logarithms.		Numbers.
5.55230	Answer	356700.
4.55230	— —	35670.
3.55230	—	3567.
2.55230	— —	356.7
1.55230	— —	35.67
0.55230	— —	3.567
$\overline{9}.55230$	— — —	.3567
$\overline{8}.55230$	— —	.03567
$\overline{7}.55230$	— —	.003567, &c.

But if the exact log. cannot be found in the table, and the number of figures required exceed four, then

1. Find as before (not regarding the index) the log. answering to the first four figures, but less than the given log.

2. Take that from the given one, and if the remainder do not consist of two figures, prefix a cypher to it; and after these two figures annex three cyphers, so will you have five figures for a dividend.

3. Divide that by the difference between the log. found, and the next following, and if your quotient do not consist of three figures prefix a cypher or cyphers to make it; which three figures place after the first four found.

Then observe the index of the given log. which shews how many figures must be integers, and how many decimals; for the number of integers is one more than the given index as before.

EXAMPLE I.

1. Required, the number of the log. 4.55241

The nearest log. which is less is 3.55230
its number is 3567.

The difference of these with three cyphers is
for a dividend - - - - 11000

The log. found - - 3.55230
The next log. - - 3.55242

Their difference will give for a divisor 12

12)11000(916 Quotient.
108
20
12
80

Which quotient place after the first four figures found, and you have 3567916; and because the index is 4, the number will be 35679.16 required.

2. Required, the number answering to the log. 5.09901

The nearest log. to which is 3.09899, its No. 1256

Dividend 02000

Log. found	3.09899
Next log.	3.09934

35 Divisor 35)02000(57
175
250
245
5

Because the quotient consists of but two figures, prefix a cypher to it to make it three, and it is 057; which annexed to the first four found, is 1256057; and because the index of the given log, is 5, its number will be 125605.7.

From what has been said on this head, the following problems may be easily solved by logarithms, *viz.*

PROB. I.

Multiply 134 by 25.6

To log. of 134 - -	2.12710
Add the log. of 25.6 - -	1.40824
Sum	3.53534

The number answering to which sum, *viz.* 3430, is nearly the product of 134 by 25.6 and is the answer.

Again, multiply 234 by 36.

To log. of 234 2.36922
Add the log. of 36 1.55630

Sum 3.92552 its number is 8424 required.

PROB. II.

What is the quotient of 828 by 23?

From the log. of 828 2.91803
Take the log. of 23 1.36173

Difference 1.55630 its number is 36 the quotient required.

Again, what is the quotient of 30550 by 47?

From the log. of 30550 4.48501
Take the log. of 47 1.67210

2.81291 its number is 650 the quotient required.

PROB. III.

Three numbers in a direct proportion given, to find a fourth.

From the sum of the logarithms of the second and third numbers; deduct the logarithm of the first, the remainder will be the logarithm of the fourth required.

Exam-

EXAMPLE I.

Let the three proposed numbers be 36, 48, 66, to find a fourth proportional.

To log. of 48	1.68124
Add log. of 66	1.81954
Sum	3.50078
Take log. of 36	1.55630
	1,94448 the number is 88 the fourth required.

Again, let three numbers be 240, 1440, 1230, to find the fourth proportional.

To the log. of 1440	3.15836
Add the log. of 1230	3.08991
From the product	6.24827
Take the log. of 240	2.38021
	3.86806 its number 7380 the 4th required.

PROB. IV.

To find the square of any given number.

Multiply the given number's logarithm by 2, and the product is the logarithm of its square.

EXAMPLE.

Required, the square of 36.

Log. of 36	1.55630
Multiply by	2
	3.11260 its number 1296

the square required.

PROB. V.

To extract the square root of any given number.

Take half of the logarithm of the number, and that is the logarithm of its square root.

EXAMPLE.

Required the square root of 1296,

Log. of 1296	3.11261
Its half is	1.55630 its number is 36 the

square root of the number required.

By the manner of projecting the lines of chords, sines, tangents, and secants (being prob. 20 of geometry) it is evident, that if the radius be supposed any number of equal parts (as 1000 or 10000, &c.) the sine, tangents, &c. of every arc, must consist of some number of those equal parts: and by computing them in parts of the radius,

dius, we have tables of sines, tangents, *&c.* to every arc of the quadrant, called natural sines, tangents, *&c.* and the logarithms of these give us tables of logarithmic sines, tangents, *&c.* and such are usually bound up with logarithms of numbers.

In which you may observe, that each page is divided into 8 columns, the first and last of which are minutes, and the intermediate ones contain the sines, tangents, and secants, the upper and lower columns contain degrees, the column of the minutes on the left hand of each page, answers to the degrees in the top column; and the sines, tangents, and secants belonging to those degrees and minutes, are in the columns marked at the top with the words sine, tangent, and secant; the column of minutes on the right hand of each page, answers to the degrees in the bottom of the page; and the sines, tangents, and secants, answering to those degrees and minutes, are in the columns, marked at the bottom with the words sine, tangent, secant; the degrees in the top column beginning at 0, proceed to 44, where they end; and those at the bottom of the page begin at 89, and proceed to 45 in a decreasing series; the degrees in the different columns being the complement of each other. From what has been said, we may easily find the sine, tangent, or secant of any arc, from the tables, by looking for the given number of degrees at the head or foot of the page, according as they are less or greater than 45, and in the proper side column for the odd minutes, if there be any; then below or above the word sine, tangent, or secant, and on the same line with the minutes, we shall have that which was required.

EXAMPLE I.

Required, the sine of 36 degrees 40 minutes.

Look at the head of the page for 36 degrees, and in the side column on the left hand, for 40 minutes; then below the word sine, on the same line with 40, we find 9.77609; which is that required.

EXAMPLE II.

Required, the tangent of 54 degrees 30 minutes.

Look at the foot of the page (because the proposed degrees are more than 45.) for 54 degrees. and in the right hand column for 30 minutes; then in the column marked tangent at its bottom, and on the same line with the 30 minutes, in the side column, we find 10.14673, which is the log-tangent required.

The reverse of this, *viz.* The logarithm of a sine, tangent, or secant, being given, to find the arc belonging to it, is performed by only looking in the proper column, for the nearest logarithm to that proposed, and the degrees and minutes answering thereto, are those required.

We will now shew how any sine, tangent, or secant may be had, though the figures in the tables were defaced, mis-printed, or obliterated.

PROB. I.

To find the tangent which is defaced, by the sine and co-sine.

The co-sine taken from the sine added to 90, or radius, which is 10.00000, the remainder is the tangent, (by part 1. theo. 24.)

EXAMPLE.

1. Suppose the tangent of 41°. 20′ was defaced, but the sine and co-sine of it visible.

From the sine of 41°. 20′+ 10.00000, or radius, - . - .	19.81983
Take the co-sine of 41°. 20′	9.87557
The rem. is the tan. of 41°. 20′ req. *viz.*	9.94426

2. To find a sine which is mis-printed, by help of the co-sine and tangent.

From the sum of the tangent and co-sine, take 10.00000, or radius, or (which is the same thing) cut off the first figure in the index, the remainder is the sine required (by part 2. theo. 24.)

EXAMPLE.

Suppose the sine of 46°. 50′. was defaced, but the tangent and co-sine visible.

To the tangent of 46°. 50′	10.02781
Add the co-sine of 46°. 50′	9.83513
Their sum is the sine of 46°. 50′ req. *viz.*	9.86294

The co-tangent and co-sine of any arc, may be had by the same method; the complement of any degree, being only its residue from 90, or a quadrant, as before observed (by theo. 24. part 3 and 4.)

3. To find a tangent by the help of a co-tangent only.

From twice the radius, which is 20.00000, take the co-tangent, the remainder is the tangent (by theo. 24. part 5.)

EXAMPLE.

Required the tangent of 29°. 50′ being defaced, as also the sine and co-sine defaced, by the co-tangent only.

From twice the radius,	20.00000
Take the co-tangent of 29°. 50′	10.24148
The rem. is the tang. of 29°. 50′ req.	9.75852

4. To find the secant by the help of a co-sine; which may be found of great use when a table of sines and tangents can only be had.

From twice the radius, which is 20.00000, take the co-sine, and the remainder will be the secant, (by theo. 24. part 6.)

EXAMPLE.

Required, the secant of 57°. 20′ by the help of the co-sine only.

From the double radius,	20.00000
Take the co-sine of 57°. 20′	9.73219
The rem. is the secant of 57°. 20′ req.	10.26781

5. To find a secant by the help of the sine and tangent.

From the tangent added to radius, take the sine, the remainder will be the secant (by theo. 24. part 7.)

EXAMPLE.

Required, the secant of 57°. 20′ by help of the sine and tangent.

From the tan. of 57°. 20′ + 10.00000
the radius, 20.19303
Take the sine of 57°. 20′ 9.92522

The rem. is the secant of 57°. 20′ req. 10.26781

The secants in these tables might have been omitted, because all proportions in which they are concerned, may be wrought by sines and tangents only, as shall be shewn in the several cases of plane trigonometry; and are here only inserted that all the various methods of resolving triangles may be shewn.

SECT.

SECT. II.

Containing Plane Trigonometry, right-angled and oblique; with its Application in determining the Measures of inaccessible Heights and Distances.

Plane Trigonometry

IS the science of measuring the sides and angles of plane triangles. It is divided into two parts, *viz.* into rectangular and oblique angular trigonometry, because every triangle is either right-angled or oblique; therefore we shall begin with

RECTANGULAR TRIGONOMETRY.

Plate V. fig. 1.

1. In every right-angled plane triangle ABC, if the hypothenuse AC be made the radius, and with it a circle, or an arc of one, be described from each end; it is plain (from def. 22.) that BC is the sine of the angle A, and AB is the sine of the angle C; that is, the legs are the sines of their opposite angles.

2. If

Plate V.

2. If one leg AB be made the radius, and with it, on the point A, an arc be described; then BC is the tangent, and AC is the secant of the angle A, by def. 24 and 25. Fig. 2.

3. If BC be made the radius, and an arc be described with it on the point C; then is AB the tangent, and AC is the secant of the angle C, as before. Fig. 3.

Because the sine, tangent or secant, of any given arc in one circle, is to the sine, tangent, or secant of a like arc (or to one of the like number of degrees) in another circle; as the radius of the one is to the radius of the other; therefore the sine, tangent, or secant of any arc is proportional to the sine, tangent, or secant of a like arc, as the radius of the given arc is to 10.00000, as the radius from whence the logarithmic sines, tangents, and secants, in most tables are calculated, i. e.

If AC be made the radius, the sines of the angle A and C, described by the radius AC, will be proportional to the sines of the like arcs, or angles in the circle, that the tables now mentioned were calculated for. So if BC was required, having the angles and AB given it will be fig. 1.

As S.C : AB : : S.A : BC.

i. e. As the sine of the angle C in the tables, is to the length of AB; (or sine of the angle C, in a circle whose radius is AC;) so is the sine of the

Plate V.

the angle A in the tables, to the length of BC, (or sine of the same angle, in the circle, whose radius is AC.)

In like manner, the tangents and secants represented by making either leg the radius, will be proportional to the tangents and secants of a like arc, as the radius of the given arc is to 10.00000, the radius of the tables aforesaid.

Hence it is plain, that if the name of each side of the triangle be placed thereon, a proportion will arise to answer the same end as before: thus if AC be made the radius, let the word radius be written thereon; and as BC and AB, are the sines of their opposite angles; upon the first let S.A, or sine of the angle A, and on the other let S.C, or sine of the angle C, be wrote: then,

When a side is required, it may be obtained by this proportion, *viz.*

As the name of the side given
  is to the side given,
So is the name of the side required
  to the side required.

Thus, if the angles A and C, and the hypothenuse AC were given, to find the legs; the proportions will be

1. R : AC : : S.A : BC. fig. 1.

That is, as radius is to AC, so is the sine of the angle A, to BC. And,

2. R : AC : : S.C : AB.

That is, as radius is to AC, so is the sine of the angle C, to AB.

When

Plate V.

When an angle is required, we use this proportion, *viz.*

As the side that is made the radius,
    is to radius,
So is the other given side,
    to its name.

Thus if the legs were given to find the angle A, and if AB be made the radius, it will be

AB : R : : BC : T.A. fig. 2.

That is, as AB, is to radius, so is BC, to the tangent of the angle A.

After the same manner, the sides or angles of all right-angled plane triangles may be found, from their proper data.

We here, in plate 4, give all the proportions requisite for the solution of the six cases in rectangular trigonometry; making every side possible the radius.

In the following triangles this mark — in an angle, denotes it to be known, or the quantity of degrees it contains to be given; and this mark′ on a side, denotes its length to be given in feet, yards, perches, or miles, &c. and this mark°, either in an angle or on a side, denotes the angle or side required.

Plate V.

From these proportions it may be observed; that, to find a side, when the angles and one side are given, any side may be made the radius: and to find an angle, one of the given sides must be made the radius. So that in the 1st, 2d, and 3d cases, any side as well required as given, may be made the radius, and in the first statings of the 4th, 5th, and 6th cases, a given side only is made the radius.

RECTANGULAR TRIGONOMETRY.

CASE 1.

THE angles and hypothenuse given, to find the base and perpendicular. fig. 4.

In the right-angled, triangle ABC, suppose the angle A 46°. 30′. and consequently the angle C 43°. 30′. (by cor. 2. theo. 5.) and AC 250 parts, (as feet, yards, miles, *&c.*) required the legs AB and BC.

Geometrically.

Make an angle of 46°. 30′. in blank lines (by prob. 16. sect. 1.) as CAB; lay 250, which is the given hypothenuse, from a scale of equal parts, from A to C; from C, let fall the perpendicular BC (by prob. 7. sect. 1.) and that will constitute the triangle ABC. Measure the lines BC, and AB, from the same scale of equal parts that AC was taken from; and you have the answer.

By

Plate V.

By Calculation.

1. *Making AC the radius*, the required sides are found by these propositions, as in plate 4. case 1.

R : AC : : S.A : BC.
R : AC : : S.C : AB.

i. e. As radius,	90°	10.00000
is to AC,	250	2.39794
So is the sine of A	46°. 30′	9.86056
to BC,	181. 4	2.25850

As radius,	90°	10.00000
is to AC,	250	2.39794
So is the sine of C	43°. 30′	9.83781
to AB,	172. 1.	2.23575

If from the sum of the second and third logs. that of the first be taken, the remainder will be the log. of the fourth; the number answering to which, will be the thing required; but when the first log. is radius, or 10.00000, reject the first figure of the sum of the other two logs. (which is the same thing as to subtract 10.00000) and that will be the log. of the thing required.

2. *Making AB the radius.*

Secant A : AC : : R : AB.
Secant A : AC : : T.A : BC.

i. e.

i. e. As the secant of A	46° 30′	10.16219
is to AC,	250	2.39794
So is radius	90°	10.00000
		12.39794
to AB,	172. 1	2.23575

As the secant of A	46° 30′	10.16219
is to AC,	250	2.39794
So is the tangent of A	46° 30′	10.02275
		12.42069
to BC,	181. 4	2.25850

3. *Making BC the radius.*

Sec. C : AC : : R : BC.
Sec. C : AC : : T. C : AB.

i. e. As the secant of C	43° 30′	10.13944
is to AC,	250	2.39794
So is radius	90°	10.00000
		12.39794
to BC,	181. 4	2.25850

As the secant of C	43° 30′	10.13944
is to AC,	250	2.39794
So is the tangent of C	43° 30′	9.97725
		12.37519
to AB,	172. 1	2.23575

Or having found one leg, the other may be obtained by cor. 2. theo. 14. sect. 1.

By Gunter's Scale.

On this scale there are lines of numbers, sines, and tangents, as well as lines of sine and tangent rumbs, versed sines, meridional parts, and equal parts; but the three first lines are sufficient for our present purpose.

The divisions on these respective lines, are the logarithms of numbers, sines and tangents, taken from a scale of equal parts, and applied on the lines of the scale.

The first and third terms in the foregoing proportions, being of a like nature, and those of the second and fourth being also like to each other; and the proportions being direct ones, it follows, that if the third term be greater or less than the first, the fourth term will be also greater or less than the second: therefore the extent in your compasses, from the first to the third term, will reach from the second to the fourth.

Thus to extend the first of the foregoing proportions;

1. Extend from 90° to 46° 30′, on the line of sines; that distance will reach from 250 on the line of numbers, to 181, for BC.

2. Extend from 90° to 43° 30′ on the line of sines; that distance will reach from 250 on the line of numbers, to 172, for AB.

If the first extent be from a greater, to a less number; when you apply one point of the compasses to the second term, the other must be turned to a less; and the contrary.

By def. 22. sect. 1. The sine of 90° is equal to the radius; and the tangent of 45° is also equal to the radius; because if one angle of a right-angled triangle be 45°, the other will be also 45°; and thence (by the lemma preceding theo. 7. sect. 1.) the tangent of 45° is equal to the radius; for this reason the line of numbers of 10.00000, the sine 90°, and tangent of 45° being all equal, terminate at the same end of the scale; where there are small brass centres, usually placed to preserve the scale.

It was said before, that the tangents ended at 45°; but because the logarithms of tangents more than 45°, must pass off the scale; such distances therefore, as exceed 45°, are set backwards from 45, and numbered 50, 60, 70, &c.

There is no line of secants on the scale; for every thing requisite can be performed without them.

Thus the two first statings of this case, answer the question without a secant: the like will be also made evident in all the following cases.

C A S E 2.

The base and angle given; to find the perpendicular and hypothenuse.

Plate V. fig. 5.

In the triangle ABC there is the angle A 42° 20′, and of course of the angle C 47° 40′ (by cor. 2. to theo. 5.) and the leg AB 190, given; to find BC and AC.

Geometrically.

Make the angle CAB (by prob. 16. sect. 1.) in blank lines, as before. From a scale of equal parts, lay 190 from A to B; on the point B, erect a perpendicular BC (by prob. 5. sect. 1.) the point where this cuts the other blank line of the angle, will be C; so is the triangle ABC constructed: let AC and BC be measured from the same scale of equal parts that AB was taken from, and you have the answer.

By Calculation.

1. *Making AC the radius.*

S. C : AB : : R : AC.
S. C : AB : : S. A : BC.

i. e. As the sine of C	47° 40′	9.86879
is to AB,	190	2.27875
So is radius	90°	10.00000
		12.27875
to AC,	257	2.40996

As the sine of C	47° 40′	9.86879
is to AB,	190	2.27875
So is the sine of A	42° 20′	9.82830
		12.10705
to BC,	173. 1	2.23826

2. *Making AB the radius.*

R : AB : : T. A : BC.
R : AB : : Sec. A : AC.

i. e. As radius	90°	10.00000
is to AB,	190	2.27875
So is the tangent of A	42° 20′	9.95952
to BC,	173. 1	2.23827

As radius	90°	10.00000
is to AB,	190	2.27875
So is the secant of A	42° 20′	10.13121
to AC,	257	2.40996

3. *Making BC the radius.*

T. C : AB : : Sec. C : AC.
T. C : AB : : R : BC.

i. e. As the tangent of C	47° 40′	10.04048
is to AB,	190	2.27875
So is the secant of C	47° 40′	10.17170
		12.45045
to AC,	257	2.40997

As the tangent of C	47° 40′	10.04048
is to AB,	190	2.27875
So is radius	90°	10.00000
		12.27875
to BC,	173. 1	2.23827

Or, having found one of the required sides, the other may be obtained, by one or the other of the cors. to theo. 14. sect. 1.

By Gunter's Scale.

1. When AC is made the radius.

Extend from 47° 40′, to 90° on the line of sines; that distance will reach from 190 to 257, on the line of numbers, for AC.

2. When AB is made the radius: the first staing is thus performed.

Extend from 45° on the tangents (for the tangent of 45° is equal to the radius, or to the sine of 90° as before) to 42° 20′; that extent will reach from 190, on the line of numbers, to 173, for BC.

3. When BC is made the radius, the second stating is thus performed.

Extend from 47° 40′, on the line of tangents, to 45° or radius; that extent will reach from 190 to 173, on the line of numbers, for BC; for the tangent of 47° 40′, is more than the radius; therefore the fourth number must be less than the second, as before.

The two first statings of this case, answer the question without a secant.

CASE. 3.

The angles and perpendicular given; to find the base and hypothenuse.

Plate V. fig. 6.

In the triangle ABC, there is the angle A 40°, and consequently the angle C 50°, with BC 170, given; to find AC and AB.

Geometrically.

Make an angle CAB of 40° in blank lines; (by prob. 16. sect. 1.) with BC 170, from a line of equal parts, draw the popped lines EF parallel to AB (by prob. 8. sect. 1.) the lower line of the angle, and from the point where it cuts the other line in C, let fall a perpendicular BC (by prob. 7. sect. 1.) and the triangle is constructed: the measures of AC and AB, from the same scale that BC was taken, will answer the question.

What has been said in the two foregoing cases, is sufficient to render the operations in this, both by calculation and Gunter's scale, so obvious, that it is needless to insert them; however, for the sake of the learner, we give for

Answer, AC 264. 5. and AB 202. 6.

CASE 4.

The base and hypothenuse given; to find the angles and perpendicular.

Plate V. fig. 7.

In the triangle ABC, there is given, AB 300 and AC 500: the angles A and C, and the perpendicular BC, are required.

Geometrically.

From a scale of equal parts, lay 300 from A to B; on B erect an infinite blank perpendicular line, with AC 500, from the same scale, and one foot of the compass, in A; cross the perpendicular line in C; and the triangle is constructed.

By prob. 17. sect. 1. Measure the angle A, and let BC be measured from the same scale of equal parts that AC and AB were taken from; and you have the answer.

By Calculation.

1. *Making AC the radius.*

AC : R : : AB : S.C.
R : AC : : S.A : BC.

i. e. As AC	500	2.69897
is to radius,	90°	10.00000
So is AB	300	2.47712
		12.47712
to the sine of C, 36° 52′		9.77815

By cor. 2. theo. 5. 90° — 36° 52′ = 53° 08′ the angle A.

As radius	90°	10.00000
is to AC,	500	2.69897
So is the sine of A	53° 08′	9.90801
to BC,	400	2.60198

2. *Making AB the radius.*

AB : R : : AC : sec. A.
R : AB : : T.A : BC.

i. e.

i. e. As AB	300	2.47712
is to radius,	90°	10.00000
So is AC	500	2.69897
		12.69897
to the secant of A 53° 08′		10.22185

As radius,	90°	10.00000
is to AB,	300	2.47712
So is the tangent of A 53°. 08′		10.12499
to BC,	400	2.60211

Or BC may be found from cor. 2. theo. 14. sect. 1.

By Gunter's Scale.

1. *Making AC the radius.*

Extend from 500 to 300, on the line of numbers; that extent will reach from 90°, on the line of sines, to 36° 52′ for the angle C.

Again, Extend from 90° to 53° 08′, on the line of sines, that extent will reach from 500 to 400, on the line of numbers, for BC.

2. Making AC the radius, the second stating is thus performed.

Extend from radius, or the tangent of 45°, to 53° 08′, that extent will reach from 300 to 400, for BC.

CASE 5.

The perpendicular and hypothenuse given to find the angles and base.

Plate V. fig. 8.

In the triangle ABC there is BC 306, and AC 370 given; to find the angles A and C, and the base AB.

Geometrically.

Draw a blank line from any point, in which, at B, erect a perpendicular, on which lay BC 306, from a scale of equal parts: from the same scale, with AC 370, in the compasses, cross the first drawn blank line in A, and you have the triangle ABC constructed.

Measure the angle A (by prob. 17. sect. 1.); and also AB, from the same scale of equal parts the other sides were taken from, and you have the answer.

The operations by calculation, the square root, and Gunter's scale, are here omitted, as they have been heretofore fully explained: the statings, or proportions must also be obvious, from what has already been said.

Answer. The angle A 55° 48′; therefore the angle C 34° 12′, and AB 208.

CASE 6.

The base and perpendicular given to find the angles and hypothenuse.

Plate V. fig. 9.

In the triangle ABC, there is AB 225, and BC 272, given; to find the angles A and C, and the hypothenuse AC.

Geometrically.

Draw a blank line, on which lay AB 225, from a scale of equal parts; at B, erect a perpendicular; on which lay BC, 272, from the same scale; join A and C, and the triangle is constructed.

As before, let the angle A, and the hypothenuse AC be measured; and you have the answer.

By Calculation.

1. *Making AB the radius.*

AB : R : : BC : T.A.
R : AB : : Sec. A : AC.

2. *Making BC the radius.*

BC : R : : AB : T.C.
R. : BC : : Sec. C : AC.

By calculation the answer from the foregoing proportions is easily obtained, as before.

But because AC, by either of the said proportions, is found by means of a secant; and since there is no line of secants on Gunter's scale; after having found the angles, as before, let us suppose AC the radius, and then

1. S. A : BC : : R. : AC.
or, 2. S. C : AB : : R. : AC.

These proportions may be easily resolved, either by calculation or by Gunter's scale as before; and thus the hypothenuse AC may be found without a secant.

From the two given legs, the hypothenuse may be easily obtained, from cor. 1. theo. 14. sect. 1.

Thus the square of AB=50625
Add the square of BC=73984

124609(353=AC
9

65)346
325

703)2109
2109

From what has been said on logarithms, it is plain,

1. That half the logarithm of the sum of the squares of the two sides, will be the logarithm of the hypothenuse. Thus,

The sum of squares, as before, is 124609; its log. is 5.09554, the half of which is 2.54777;

and the corresponding number to this, in the tables, will be 353, for AC.

2. And that half of the logarithm of the difference of the squares of AC and AB, or of AC and BC, will be the logarithm of BC, or of AB.

The following examples are inserted for the use of the learner.

$$1.\ \text{Given,}\ \left\{\begin{array}{rr}\text{the angle C} & 64^\circ\,40'\\ \text{AC} & 3876\end{array}\right.\ \left\{\begin{array}{l}\text{AB}\\ \text{BC}\end{array}\right.\ \text{required.}$$

$$2.\ \text{Given,}\ \left\{\begin{array}{rr}\text{the angle C} & 47^\circ\ 20'\\ \text{AB} & 17\end{array}\right.\ \left\{\begin{array}{l}\text{AC}\\ \text{BC}\end{array}\right.\ \text{required,}$$

$$3.\ \text{Given,}\ \left\{\begin{array}{rr}\text{the angle C} & 28^\circ\ 30'\\ \text{BC} & 27187\end{array}\right.\ \left\{\begin{array}{l}\text{AB}\\ \text{AC}\end{array}\right.\ \text{required,}$$

$$4.\ \text{Given,}\ \left\{\begin{array}{rr}\text{AB} & 2\\ \text{AC} & 3\end{array}\right.\ \left\{\begin{array}{l}\text{the angles}\\ \text{and BC}\end{array}\right.\ \text{required.}$$

$$5.\ \text{Given,}\ \left\{\begin{array}{rr}\text{BC} & 17\\ \text{AC} & 21.6\end{array}\right.\ \left\{\begin{array}{l}\text{the angles}\\ \text{and AB}\end{array}\right.\ \text{required.}$$

$$6.\ \text{Given,}\ \left\{\begin{array}{rr}\text{AB} & 2871.64\\ \text{BC} & 3176.2\end{array}\right.\ \left\{\begin{array}{l}\text{the angles}\\ \text{and AC}\end{array}\right.\ \text{required,}$$

The answers are omitted, that the learner may resolve them himself by the foregoing methods; by which means he will find and see more distinctly their mutual agreements; and become more expert, and the better acquainted with the subject.

OBLIQUE

OBLIQUE ANGULAR

PLANE TRIGONOMETRY.

BEFORE we proceed to the solution of the four cases of Oblique angular triangles, it is necessary to premise the following theorems.

THEO. I.

Plate V.

In any plane triangle ABC, the sides are proportional to the sines of their opposite angles, i. e. *S. C : AB : : S. A : BC, and S. C : AB : : S. B : AC ; also S. B : AC : : S. A : BC. fig.* 10.

By theo. 10. sect. 1. the half of each side is the sine of its opposite angle; but the sines of those angles, in tabular parts, are proportional to the sines of the same in any other measure; and therefore the sines of the angles will be as the halves of their opposite sides: and since the halves are as the wholes, it follows, that the sines of their angles are as their opposite sides, i. e. S. C : AB : : S. A : BC, &c. Q. E. D.

THEO. II.

In any plane triangle ABC, the sum of the two given sides AB and BC, including a given angle ABC, is to their difference, as the tangent of half the sum of the two unknown angles A and C is to the tangent of half their difference. Fig. 11.

Produce

Plate V.

Produce AB and make HB=BC, and join HC: let fall the perpendicular BE, and that will biſect the angle HBC (by theo. 9. ſect 1.) through B draw BD parallel to AC, and make HF=DC, and join BF; take BI=BA, and draw IG parallel to BD or AC.

It is then plain, that AH will be the sum, and HI the difference of the ſides AB and BC: and ſince HB=BC, and BE perpendicular to HC, therefore HE=EC (by theo. 8. ſect. 1.); and ſince BA=BI, and BD and IG parallel to AC, therefore GD=DC=FH, and conſequently HG=FD, and $\frac{1}{2}$ HG=$\frac{1}{2}$ FD or ED. Again, EBC being half HBC, will be alſo half the sum of the angles A and C (by theo. 4, ſect. 1.) Alſo, ſince HB, HF, and the included angle H, are ſeverally equal to BC, CD, and the included angle BCD; therefore (by theo. 6. ſect. 1.) HBF = DBC = BCA (by part 2. theo. 3. ſect. 1.) and ſince HBD = A (by part 3. theo. 3. ſect. 1.) and HBF=BCA; therefore BFD is the difference, and EBD, half the difference of the angles A and C: then making BE the radius, it is plain, that EC will be the tangent of half the sum, and ED the tangent of half the difference of the two unknown angles A and C: now IG being parallel to AC; AH : IH : : CH : GH. (by cor. 1. theo. 20. ſect. 1.) But the wholes are as their halves, i. e. AH : IH : : CE : ED, that is, as the sum of the two ſides AB and BC, is to their difference; ſo is the tangent of half the sum of the two unknown angles A and C, to the tangent of half their difference. Q. E. D.

Plate V.

THEO. III.

In any right-lined plane triangle ABD; the base AD, will be to the sum of the other sides, AB, BD, as the difference of those sides, is to the difference of the segments of the base, made by the perpendicular BE; viz. *the difference between AE and ED. fig.* 12.

Produce BD, till BG=AB the lesser leg; and on B as a centre, with the distance BG or BA, describe a circle AGHF; which will cut BD, and AD in the points H and F: then it is plain, that GD will be the sum, and HD the difference of the sides AB and BD; also since AE=EF (by theo. 8. sect. 1.) therefore, FD is the difference of AE and ED, the segments of the base: but (by theo. 17. sect. 1.) AD : GD : : HD : FD; that is, the base is to the sum of the other sides, as the difference of those sides, is to the difference of the segments of the base. Q. E. D.

THEO. IV.

If to half the sum of two quantities, be added half their difference; the sum will be the greatest of them; and if from half the sum be subtracted half their difference, the remainder will be the least of them. Fig. 13.

Let the two quantities be represented by AB and BC; (making one continued line;) whereof AB is the greatest, and BC the least; bisect the whole line AC in E; and make AD=BC; then it

Plate V.

it is plain that AC is the sum, and DB the difference of the two quantities; and AE or EC, their half sum, and DE or EB, their half difference. Now if to AE we add EB, we shall have AB, the greatest quantity; and if from EC we take EB, we shall have BC the least quantity. Q. E. D.

Cor. Hence, if from the greatest of two quantities, we take half the difference of them, the remainder will be half their sum; or if to half their difference be added the least quantity, their sum will be half the sum of the two quantities.

Oblique Angular Trigonometry.

TWO sides and an angle opposite to one of them given; to find the other angles and side.

In the triangle ABC, there is given AB 240, *the angle A* 46° 30′, *and BC* 200; *to find the angle C, being acute, the angle B, and the side AC. fig.* 14.

Geometrically.

Draw a blank line, on which set AB 240, from a scale of equal parts; at the point A, of the line AB, make an angle of 46° 30′, by an infinite blank line; with BC 200, from a like scale of equal parts that AB was taken, and one foot in B, describe the arc DC to cut the last blank line in the points D and C. Now if the angle C had been required obtuse, lines from D to B, and

Plate V.

to A, would constitute the triangle; but as it is required acute, draw the lines from C to B, and to A, and the triangle ABC is constructed. From a line of chords let the angles B and C be measured; and AC from the same scale of equal parts that AB and BC were taken; and you will have the answer required.

By Calculation.

This is performed by theo. 1. of this sect. thus;

As BC	200	2.30103
is to the sine of A	46° 30′	9.86056
So is AB	240	2.38021
		12.24077
to the sine of C,	60° 31′	9.93974

180—the sum of the angles A and C, will give the angle B; by cor. 1. theo. 5. sect. 1.

A 46° 30′
C 60 31

180—107. 10=72° 59′=B.

As the sine of A	46° 30′	9.86056
is to BC,	200	2.30103
So is the sine of B	72° 59′	9.98056
		12.28159
to AC,	263. 7	2.42103

By

Plate V.

By Gunter's Scale.

Extend from 200 to 240, on the line of numbers; that distance will reach from 46° 30′ on the line of sines, to 60° 31′ for the angle C.

Extend from 46° 30′, to 72° 59′, on the line of sines; that distance will reach from 200 to 263.7 on the line of numbers, for AC.

CASE. 2.

Two angles and a side given; to find the other sides.

In the triangle ABC, there is the angle A 46° 30′, *AB* 230, *and the angle B* 37° 30′ *given to find AC and BC. fig.* 15.

Geometrically.

Draw a blank line, upon which set AB 230, from a scale of equal parts; at the point A of the line AB, make an angle of 46° 30′, by a blank line; and at the point B of the line AB make an angle of 37° 30′, by another blank line; the intersection of those lines gives the point C, so is your triangle ABC constructed. Measure AC and BC from the same scale of equal parts that AB was taken; and you have the answer required.

By Calculation.

By (cor. 1. theo. 5. sect. 1.) 180—the sum of the angles A and B=C.

A 46°

Plate V.

A 46° 30′
B 37. 30

180—84. 00=96° 00′=C.

By def. 29. sect. 1. The sine of 96°=the sine of 84°, which is the supplement thereof; therefore instead of the sine of 96°, look in the tables for the sine of 84°.

By theo. 1. of this sect.

As the sine of C	96° 00′	9.99761
is to AB,	230	2.36173
So is the sine of A	46° 30′	9.86056
		12.22229
to BC,	167.8	2.22468

As the sine of C	96° 00′	9.99761
is to AB,	230	2.36173
So is the sine of B	37° 30′	9.78445
		12.14618
to AC,	140.8	2.14857

By Gunter's Scale.

Extend from 84° which is the supplement of 96°) to 46° 30′ on the sines; that distance will reach from 230 to 168, on the line of numbers, for BC.

Extend

Plate V.

Extend from 84° to 37° 30′, on the sines; that extent will reach from 230 to 141, on the line of numbers, for AC.

CASE 3.

Two sides and a contained angle given; to find the other angles and side.

In the triangle ABC, there is AB 240, *the angle A* 36° 40′ *and AC* 180, *given; to find the angles C and B, and the side BC, fig.* 16.

Geometrically.

Draw a blank line, on which from a scale of equal parts, lay AB 240; at the point A of the line AB, make an angle of 36° 40′, by a blank line; on which from A, lay AC 180, from the same scale of equal parts; measure the angles C and B, and the side BC, as before; and you have the answer required.

By Calculation.

By cor. 1. theo. 5. sect. 1. 180 — the angle A 36° 40′ = 143° 20′ the sum of the angles C and B: therefore half of 143° 20′, will be half the sum of the two required angles, C and B.

By theo. 2. of this sect.

As the sum of the two sides AB and AC 420
is to their difference, 60

So

Plate V.

So is the tangent of half the sum of the two unknown angles C and B	71° 40′
to the tangent of half their difference	23° 20′

By theo. 4.

To half the sum of the angles C and B	71°	40′
Add half their difference as now found	23	20
The sum is the greatest angle, or ang. C	95	00
Subtract, and you have the least angle, or B	48	20

The angles C and B, being found; BC is had, as before, by theo. 1. of this sect. Thus,

S. B : AC : : S : A : BC.
48° 20′ 180 36° 40′ 143. 9.

By Gunter's Scale.

Because the two first terms are of the same kind, extend from 420 to 60 on the line of numbers; lay that extent from 45° on the line of tangents, and keeping the left leg of your compasses fixed, move the right leg to 71° 40′; that distance laid from 45° on the same line, will reach to 23° 30′, the half difference of the required angles. Whence the angles are obtained, as before.

The second proportion may be easily extended, from what has been already said.

CASE

Plate V.

CASE 4.

The sides given, to find the angles.

In the triangle ABC, there is given, AB 64, *AC* 47, *BC* 34 *: the angles A, B, C, are required. fig.* 18.

Geometrically.

The construction hereof must be manifest, from prob. 1. sect. 1.

By Calculation.

From the point C, let fall the perpendicular CD on the base AB; it will divide the triangle into two right angled ones, ADC and CBD; as well as the base AB, into the two segments, AD and DB.

AC	47
BC	34
Sum	81
Difference	13

By theo. 3. of this sect.

As the base or the longest side, AB	64
is to the sum of the other sides, AC and BC,	81
So is the difference of those sides	13
to the difference of the segments of the base AD, DB.	1 .46

By

Plate V.

By theo. 4. of this sect.

To half the base, or to half the sum of the segments AD and DB	32
Add half their difference, now found.	8.23
Their sum will be the greatest segment AD	40.23
Subtract, and their difference will be the least segment DB	23.77

In the right angled triangle ADC, there is AC 47, and AD 40. 23, given, to find the angle A.

This is resolved by case 4. of right angled plane trigonometry, thus,

AD : R : : AC : Sec. A.
40. 23 : 90° : : 47 : 31° 08′

Or it may be had by finding the angle ACD, the complement of the angle A; without a secant, thus,

AC : R : : AD : S. ACD.
47 : 90 : : 40. 23 : 58° 52′

90—58° 52′=31° 08′, the angle A.

Then, by theo. 1. of this sect.

BC : S. A : : AC : S. B.
34 : 31° 08 : : 47 : 45° 37′.

By cor. 1. theo. 5. sect 1. 180 — the sum of A and B=C.

$$\begin{array}{l} A\ 31^\circ\ 08' \\ B\ 45\ \ 37 \\ \hline \end{array}$$

180—76 45=103° 15′, the angle C.

By Gunter's Scale.

The first proportion is extended on the line of numbers; and it is no matter whether you extend from the first to the third, or to the second term, since they are all of the same kind: If you extend to the second, that distance applied to the third, will give the fourth; but if you extend from the first to the third, that extent will reach from the second to the fourth.

The methods of extending the other proportions, have been already fully treated of.

An example in each case of oblique angular trigonometry.

$$1.\ \text{Given,} \left\{ \begin{array}{lr} AC & 290 \\ \ \ C\ 69^\circ & 30 \\ AB & 350 \end{array} \right\} \begin{array}{l} A \\ B \\ BC \end{array} \text{required.}$$

$$2.\ \text{Given,} \left\{ \begin{array}{lr} C & 24^\circ\ 20' \\ B & 128\ \ 30 \\ AC & 3246 \end{array} \right\} \begin{array}{l} AB \\ \\ BC \end{array} \text{required.}$$

$$3.\ \text{Given,} \left\{ \begin{array}{lr} AC & 6 \\ C\ 124^\circ & 30' \\ BC\ 4 & 5 \end{array} \right\} \begin{array}{l} A \\ B \\ AB \end{array} \text{required.}$$

Plate V.

4. Given, $\left\{\begin{array}{ll}\text{AB} & 46\\ \text{AC} & 92\\ \text{BC} & 52\end{array}\right\}\begin{array}{l}\text{A}\\ \text{B}\\ \text{C}\end{array}$ required.

Having thus gone through plane trigonometry, we shall now proceed to apply the same, in determining the measures of inaccessible heights and distances. And first,

OF

HEIGHTS.

Plate V.

THE instrument of least expence for taking heights, is a quadrant, divided into 90 equal parts or degrees; and those may be subdivided into halves, quarters, or eighths, according to the radius, or size of the instrument; its construction will be evident by the scheme thereof. (Fig. 18.)

From the centre of the quadrant let a plummet be suspended by a horse hair, or a fine silk thread, of such a length that it may vibrate freely, near the edge of its arc: by looking along its edge AC, to the top of the object whose height is required; and holding it perpendicular, so that the plummet may neither swing from it, nor lie on it; the degree then cut by the hair, or thread, will be the angle of altitude required.

If the quadrant be fixed upon a ball and socket on a three legged staff, and if the stem from the ball be turned into the notch of the socket, so as to bring the instrument into a perpendicular position, the angle of altitude by this means, can be acquired with much greater certainty.

Plate V.

An angle of altitude may be also taken by any of the instruments used in surveying; as shall be particularly shewn, when we treat of their descriptions and uses.

Most quadrants have a pair of sights fixed on the edge AC, with small circular holes in them; which are useful in taking the sun's altitude, requisite to be known in many astronomical cases; this is effected by letting the sun's ray, which passes thro' the upper sight, fall upon the hole in the lower one; and the degree then cut by the thread, will be the angle of the sun's altitude; but those sights are useless for our present purpose, for looking along the quadrant's edge to the top of the object will be sufficient, as before.

PROB. I.

Plate V. fig. 19.

To find the height of a perpendicular object at one station, which is on an horizontal plane.

A steeple.

Given,
- The angle of altitude, 53 degrees.
- Distance from the observer to the foot of the steeple, or the base, 85 feet.
- Height of the instrument, or of the observer, 5 feet.

Required, the height of the steeple.

The figure is constructed and wrought, in all respects, as case 2. of right angled trigonometry; only there must be a line drawn parallel to, and beneath

Plate V. fig. 19.

beneath AB of 5 feet for the observer's height, to represent the plane upon which the object stands; to which the perpendicular must be continued, and that will be the height of the object.

Thus, AB is the base, A the angle of altitude, BC the height of the steeple from the instrument, or from the observer's eye if he were at the foot of it, DC the height of the steeple above the horizontal surface.

Various statings for BC, as in case 2. of right-angled plane trigonometry.

90°
53 =A
—
37 =C
—

1. S. C : AB : : S. A : BC
37° 85 53° 112. 8.

2. R. : AB : : T. A : BC.
90° 85 53° 112. 8

3. T. C : AB : : R. : BC.
37° 85 90° 112. 8.

To BC 112. 8
Add DB 5. the height of the observer.

Their sum is 117. 8 or 118 feet, the height of the steeple required.

PROB.

PROB. II.

Plate V. fig. 20.

To find the height of a perpendicular object, on an horizontal plane; by having the length of the shadow given.

Provide a rod or staff, whose length is given, let that be set perpendicular, by the help of a quadrant thus; apply the side of the quadrant, AC, to the rod, or staff; and when the thread cuts 90° it is then perpendicular; the same may be done by a carpenter's, or mason's plumb.

Having thus set the rod or staff perpendicular, measure the length of its shadow, when the sun shines, as well as the length of the shadow of the object, whose height is required; and you have the proper requisites given. Thus,

ab, the length of the shadow of the staff, 15 feet.

cb, the length of the staff, 10 feet.

AB, the length of the shadow of the steeple, or object, 135 feet.

Required BC, the height of the object.

The triangles *abc*, ABC, are similar, thus; the angle b=B, being both right; the lines *ac*, AC are parallel, being rays, or a ray of the sun; whence the angle a=A (by part 3. theo. 3. sect. 1.) and consequently c=C. The triangles being therefore mutually equiangular, are similar (by theo. 16. sect. 1.) it will be,

ab : *bc* : : AB : BC.

15 10 135 90. the steeple's height required.

The foregoing method is most to be depended on; however, this is mentioned for variety's sake.

PROB. III.

To take the altitude of a perpendicular object, at the foot of a hill, from the hill's side.

Turn the centre A of the quadrant, next your eye, and look along the side AC, or 90 side, to the top and bottom of the object; and noting down the angles, measure the distance from the place of observation to the foot of the object. Thus,

Given, { Angle to the foot of the object, *55°* $\frac{1}{4}$ or *55° 15′*.
Angle to the top of it, 31°$\frac{1}{4}$ or 31° 15′.
Distance to the foot of it, 250 feet.

Required, the height of the object.

Geometrically.

Draw an infinite blank line AD, at any point in which A, make the angle EAB of *55° 15′*, and EAC of 31° 15′; lay 250 from A to B; from B, draw the perpendicular BE (by prob. 7. of geometry). crossing AC in C; so will BC be the height of the object required.

In

Plate V. fig. 21.

In the triangle ABC there is given,

ABE the complement of EAB to 90°, which is 34° 45′.

ACB the difference of the given angles 24° 00′.

The side AB. 250. Required BC.

This is performed as case 2. of oblique angular trigonometry. Thus,

180—the sum of ABE 34° 45′, and CAB 24° 00′=ACB 121° 15′. Then,

S. ACB : AB : : S. CAB : BC.
121° 15′ 250 24° 00′ 119, the height required.

PROB. IV.

Plate V. fig. 22.

To take the altitude of a perpendicular object, on the top of a hill, at one station; when the top and bottom of it can be seen from the foot of the hill.

As in prob 1. take an angle to the top, and another to the bottom of the object; and measure from the place of observation to the foot of the object, and you have all the given requisites. Thus,

A tower on a hill.

Given, { Angle to the bottom, 48° 30′.
Angle to the top, 67° 00′.
Dist. to the foot of the object, 136 feet.

Required, the height of the object.

Geo.

Plate V. fig. 22.

Geometrically.

Make the angle DAB=48° 30′, and lay 136 feet from A to B; from B, let fall the perpendicular BD; and that will be the height of the hill: produce BD upwards by a blank line: again, at A make the angle DAC=67° 00′ by a blank line, and from C where that crosses the perpendicular produced, draw the line CB, and that will be the height of the object required.

Let AC be drawn.

In the triangle ABC, there is given,

The angle ACD the complement of DAC= 23° 00′.

CAB the difference between the two given angles=18° 30′.

And the side AB 136. To find BC.

S. C	: AB	: : S.CAB	: BC.
23°	136	18° 30′	$110\frac{1}{2}$.

If BD were wanted, it is easily obtained, by the first case of right angled plane trigonometry.

PROB. V.

To take an inaccessible perpendicular altitude, on an horizontal plane.

Plate V. fig. 23.

This is done at two stations, thus;

Plate V. fig. 23.

Let DC be a tower which cannot be approached, by means of a moat or ditch, nearer than B; at B, take an angle of altitude to C: measure any convenient distance backward to A, which note down: at A, take another angle to C; so have you the given requisites, thus;

Given, { First angle, 55° 00′.
Stationary distance, 87 feet.
Second angle, 37° 00′.

The height of the tower CD, is required.

Geometrically.

Upon an infinite blank line, lay off the stationary distance 87, from A to B; from B set off your first; and from A, your second angle; from C, the point of intersection of the lines which form these angles, let fall the perpendicular CD; and that will be the height of the object required.

The external angle CBD, of the triangle ABC; is equal to the two internal opposite ones, A, and ACB (by theo. 4. sect. 1.) wherefore if one of the internal opposite angles be taken from the external angle; the remainder will be the other internal opposite one, thus;

CBD 55°—A 37°=ACB 18°.

Therefore in the triangle ABC; we have the angles A, and ACB, with the side AB given; to find BC.

S.ACB

Plate V. fig. 23.

S. ACB : AB : : S. A : BC.
18° 87 37° 169.4

Having found BC, we have in the triangle BCD, the angle CBD 55° consequently BCD 35° and BC 169.4; to find DC.

This is performed by case the first, of right-angled trigonometry, three several ways; thus:

1. R : BC : : S. CBD : DC.
90° 169.4 55° 138.8
The height required.

2. Sec. CBD : BC : : T. CBD : DC.
55° 169.4 55° 138.8
The height required.

3. Sec. CDB : BC : : R : CD.
35° 169.4 90° 138.8
The height required.

If BD, the breadth of the moat, were required; it may also be found, by three different statings, as in the first case of right angled plane trigonometry.

PROB. VI.

Plate V. fig. 24.

Let BC, a may-pole, whose height is 100 feet, be broken at D; the upper part of which, DC, falls upon a horizontal plane, so that its extremity, C, is 34 feet from the bottom or foot of the pole.

Required, the segments BD and DC.

Geo-

Geometrically.

Lay 34 feet from A to B; on B erect the perpendicular BC of 100 feet; and draw AC: bisect AC (by prob. 4. sect. 1.) with the perpendicular line, EF; and from D, where it cuts the perpendicular BC, draw AD, which will be the upper segment; and DB will be the lower.

By cor. to lemma preceding theo. 7. sect. 1, AD = DC; and (by the lemma) the angle C= CAD.

In the triangle ABC, find C, as in case 6, of right-angled trigonometry, thus,

1. BC : R : : AB : T. C=GAD.
100 90° 34 18° 47′

By theo. 4. sect. 1. The external angle ABD =37° 34′ or to twice the angle C, i. e. to C and GAD.

Then in the triangle ABD, there is ADB 37° 34′ therefore also its complement DAB 52° 26′ and AB 34, given, to find AD and BD.

By the second case of rectangular trigonometry.

2. S. ADB : AB : : R : AD or DC.
37° 34′ 34 90° 55.77.

BC—DC=BD.
100—55.77=44.23 required.

These may be had from other statings, as in the second case aforesaid.

PROB. VII.

To take the altitude of a perpendicular object on a hill, from a plane beneath it.

Plate V. fig. 25.

This is done at two stations, thus;

Let the height DC, of a wind-mill on a hill be required.

From any part of the plane whence the foot of the object can be seen, let angles be taken to the foot and top; measure thence any convenient distance towards the object, and at the end thereof, take another angle to the top; and you have the proper requisites, thus;

First station.	Angle to the foot DAB 21° 00′
	Angle to the top CAB 35° 00′
	Stationary distance AB 104 feet.
Second station.	Angle to the top 48° 30′

DC required,

Geometrically.

On an infinite blank line, lay the stationary distance AB 104 feet; from A, set off the second, and from B, the third given angle; and from the inter-

Plate V. fig. 25.

intersecting point C of the lines formed by them, let fall the perpendicular CE: from A set off the first angle, and the line formed by it will determine the point D. Thus have we the height of the hill, as well as that of the wind mill.

The angle CBE—A=ACB, as in the last prob.

In the triangle ABC, find AC thus,

S.ACB : AB : : S.ABC (or sup. of CBE) : AC
13° 30′ : 104 : : 131° 30′ : 333.6

The angle CAE—DAE=CAD.

The angle ADC=AED+EAD, by theo. 4.

In the triangle CAD, find CD thus,

S.ADC : AC : : S.CAD : DC
111° : 333.6 : : 14 ; 86.46 required.

CE, BE, or DE, may be found by other various statings, as set forth in the first and second cases of rectangular trigonometry.

PROB.

Plate V. fig. 26.

PROB. VIII.

To find the length of an object, that stands obliquely on the top of a hill, from a plane beneath.

Let CD be a tree whose length is required.

This is done at two stations.

Make a station at B, from whence take an angle to the foot, an another to the top of the tree; measure any convenient distance backward to A, from whence also let an angle be taken to the foot and another to the top; and you have the requisites given. Thus,

First station. Angle to the foot EBD=36° 30′.
Angle to the top EBC = 44° 40′.
Stationary distance AB=104 feet.

Second station. Angle to the foot EAD=24° 30′.
Angle to the top EAC=32° 00′.

Let DC and DE be required.

The geometrical constructions of this and the next problem are omitted: as what has been already said, and the figures, are looked upon as sufficient helps.

EBC — A = ACB, or 44° 30′—32°=12° 30′, as before.

In

Plate V. fig. 26.

In the triangle ABC, find BC. Thus;

1. S.ACB : AB : : S. A : BC.
12° 30′ 104 32° 254.7.

EBD—EAD=ADB, or 36° 30′—24° 30′=12° 00′

In the triangle ADB, find DB. Thus;

2. S. ADB : AB : : S. DAB : DB.
12° 00′ 104 24° 30′ 207.4.

CBE—DBE=CBD, or 44° 30′—36° 30′=8° 00′.

In the triangle CBD there is given, CB 254.7, DB 207.4, and the angle CBD 8° 00′; to find DC.

This is performed as case 3, of oblique angular trogonometry, thus;

3. BC+BD : BC—BD : : T. of ½ BDC+BCD :
462.1. 47.3 86° 00′.
T. of ½ BDC—BCD.
55° 40′.
86° 00′+55° 40′=141° 40′=BDC.
86° 00′—55° 40′=30° 20′=BCD.

4. S. BCD : BD : : S. CBD : DC.
30° 20′ 207.4 8° 00′ 57.15 length of the tree.

To find DE, in the triangle DBE.

Say R. : BD : : S. DBE : DE.
90° 207.4 36°30′ 123.4 height of the hill.

PROB.

PROB. IX.

To find the height of an inaccessible object CD, on a hill BC, from ground that is not horizontal.

Plate VI. fig. 1.

From any two points, as G and A, whose distance GA, is measured, and therefore given; let the angles HGD, BAD, BAC, and EAG, be taken; because GH is parallel to EA (by part 2. theo. 3. sect. 1.) the angle HGA=EAG; therefore EAG +HGD=AGD: and (by cor. 1. theo. 1. sect. 1.) 180—the sum of EAG and BAD=GAD; and (by cor. 1. theo. 5. sect. 1.) 180—the sum of the angles AGD and GAD=GDA: thus we have the angles of the triangle AGD, and the side AG given; thence (by case 2, of obl. trig.) AD may be easily found. The angle DAB—CAB =DAC, and 90°—BAD=ADC: and 180°—the sum of DAC and ADC=ACD: so have we the several angles of the triangle ACD given, and the side AD; whence (by case 2. of obl. trig.) CD may be easily found. We may also find AC, which with the angle BAC, will give CB, the height of the hill.

The solutions of the several problems in heights and distances, by Gunter's scale, are omitted; because every particular stating has been already shewn by it, in the rectangular and oblique angular trigonometry.

OF

DISTANCES.

ANY of the instruments used in surveying, will give you the angles or bearings of lines; which will be particularly shewn, when we come to treat of them.

PROB. I.

Plate VI. fig. 2.

Let A and B be two houses on one side of a river, whose distance asunder is 293 perches: there is a tower at C on the other side of the river, that makes an angle at A, with the line AB of 53° 20′; and another at B, with the line BA of 66° 20′: required the distance of the tower from each house. viz. AC and BC.

This is performed as case 2. of oblique angled trigonometry, thus;

1. S. C : AB : : S. A : BC
60° 20′ 293 53° 20′ 270. 5.

2. S. C : AB : : S. B : AC.
60° 20′ 293 66° 20′ 308.8

PROB.

PROB II.

Plate VI. fig. 11.

Let B and C, be two houses whose direct distance asunder, BC, is inaccessible: however it is known that a house at A, is 252 perches from B, and 230 from C; and that the angle BAC, is found to be 70°. What is the distance BC, between the two houses?

This is performed as case 3. of oblique angular trigonometry, thus;

1. AB+AC ; AB—AC : : T. of $\frac{1}{2}$ C+B ;
   482 22 55° 00′

   T of $\frac{1}{2}$C—B
   3° 44′

55° + 3° 44′=58° 44′=C. 55° — 3° 44′=51° 16′=B.

2. S. C: AB : : S. A : BC.
   58° 44′ 252 70° 277.

PROB. III.

Plate VI. fig. 3.

Suppose ABC a triangular piece of ground, which by an old survey we find to be thus: AB 260, AC 160, BC 150 perches: the mearing lines AC and BC, are destroyed or plowed down, and the line AB, only remaining. What angles must be set off at A and B, to run new mearings by, exactly where the old ones were?

This is performed as in case 4. of oblique angled trigonometry, thus;

1. AB : AC + BC : : AC—BC : AD—DB,
260 310 10 11.92

130 + 5.96 = 135.96 = AD,
130—5.96 = 124.04 = DB;

2. AD : R : : AC : Sec. A.
136 90° : : 160 31° 47′

3. BC : S. A : : AC : S. B.
150 31° 47′ 160 34° 10.

PROB. IV.

Plate VI. fig. 4.

Let D and C, be two trees in a bog, to which you can have no nearer access than at A and B: there is given, DAB 100°, CAB 36° 30′, CBA 121°, DBA 49°, and the line AB 113 perches. Required the distances of the trees DC.

180°—the sum of DBA and DAB = ADB = 31°.
180°—the sum of CAB and CBA = ACB = 22. 30.

In the triangle ABD, find DB, thus;

1, S. ADB : AB : : S. DAB : DB.
31° 113 : : 100° 216.

And in the triangle ABC, find BC, thus;

2. S. ACB : AB : : S. CAB : BC.
22° 30′ 113 36° 30′ 175.6.

In the triangle DBC, you have DBC=ABC—ABD=72°; likewise the sides BD, BC, as before found, given to find DC.

3. BD+BC : BD—BC : : T. of ½ DCB+CDB :
391.6 40.4 54°

T. of ½ DCB—CDB.
8° 05′

54°+8° 05=62° 05=DCB.
54°—8° 05=45° 55=CDB.

4. S. CDB : BC : : S. DBC : DC.
45° 55′ 175.6 72° 232.5

LEMMA.

Plate VI. fig. 10.

If from a point C, of a triangle ABC, inscribed in a circle, there be a perpendicular CD let fall upon the opposite side AB; that perpendicular is to one of the sides, including the angle, as the other side, including the angle, is to the diameter of the circle, i. e. DC : AC : : CB : CE.

Let the diameter CE be drawn and join EB; it is plain the angle CEB=CAB (by cor. 2. theo. 7. sect. 1.) and CBE is a right angle (by cor. 5. theo. 7. sect. 1.) and =ADC; whence ECB=

ACD. The triangles CEB, CAD, are therefore mutually equiangular, and (by theo. 16. sect. 1.) DC : AC : : CB : CE, or DC : CB : : AC : CE, Q. E. D.

PROB. V.

Plate VI. fig. 5.

Let three gentlemen's seats, A, B, C, be situate in a triangular form: there is given, AB 2. 5 miles, AC 2. 3, and BC 2. It is required to build a church at E, that shall be equi-distant from the seats A, B, C. What distance must it be from each seat, and by what angle may the place of it be found?

Geometrically.

By prob. 15. sect. 1. Find the centre of a circle that will pass through the points A, B, C; and that will be the place of the church; the measure of which, to any of these points, is the answer for the distance: draw a line from any of the three points to the centre, and the angle it makes with either of the sides that contain the angle it was drawn to; that angle laid off by the direction of an instrument, on the ground, and the distance before found, being ranged thereon, will give the place of the church required.

By Calculation.

1. AB : AC+BC : : AC—BC : AD—DB.
2.5 4.3 .3 .516.

1.25+.258=1.508=AD.

By cor. 2. theo. 14. sect. 1. The square root of the difference of the squares of the hypothenuse AC, and given leg AD, will give DC.

i. e. 5.29—2.274064=3.015936.

Its square root is 1.736=CD.

Then by the preceding lemma,

2. CD : AC : : CB : the diameter.
1.736 2.3 2 2.65.

the half of which, *viz.* 1.325 is the semi-diameter. or distance of the church from each seat, that is, AE; CE, BE.

From the centre E, let fall a perpendicular upon any of the sides, as EF, and it will bisect in E: (by theo. 8. sect. 1.)

Wherefore AF=CF=$\frac{1}{2}$AC=1.15.

In the right angled triangle AFE, you have AF 1.15, and AE the radius 1.325 given, to find FAE, thus;

3. AF : R. : : AE : Sec. FAE.
1.15 90° 1.325 29° 47′.

Wherefore directing an instrument to make an angle of 29° 47′, with the line AC; and measuring 1.325 on that line of direction, will give the place of the church, or the centre of a circle that will pass through A, B, and C.

The above angle FAE, may be had without a secant, as before, thus;

AE : R. : : AF : S. AEF.
1.325 90° 1.15 60° 13'.

Its complement 29° 47', will give FAE, as before.

The questions that may be proposed on this head being innumerable, we have chosen to give only a few of the most useful.

SECT. III.

Containing a particular Description of the several Instruments used in Surveying, with their respective Uses. And first,

OF THE

CHAIN.

THE stationary distance, or mearings of ground, are measured either by Mr. Gunter's chain of four poles or perches, which consist of 100 links; (and this is the most natural division) or by one of 50 links, which contains two poles or perches: but because the length of a perch differs in many places, therefore the lengths of chains and their respective links will differ also.

The *English statute perch* is 5½ yards, the two-pole chain is 11 yards, and the four-pole one is 22 yards: hence the length of a link in a statute-chain is 7.92 inches.

There are other perches used in different parts of England, as the perch of *woodland-measure*, which is 6 yards; that of *church land-measure*, which is 7 yards (or the same with the *plantation-perch*) and the *forest measure perch*, which is 8 yards.

The *Irish* or *plantation perch*, is 7 yards, as before; the two-pole chain is 14; and the four-pole one is 28 yards: hence the length of a link in a plantation chain is 10.08 inches.

The *Scotch perch* is 18$\frac{1}{2}$ feet, or 6$\frac{1}{6}$ yards, or 6 Scot's ells. In the shire of Cunningham in Scotland, their perch is 18$\frac{3}{4}$ feet, and this perch is used in some few places in the north part of Ireland, as the statute perch is in some other parts.

For the more ready reckoning the links of a four-pole chain, there is a large ring, or sometimes a round piece of brass fixed at every 10 links; and at 50 links, or in the middle, there are two large rings. In such chains as have a brass piece at every 10 links there is the figure 1 on the first piece, 2 on the second, 3 on the third, &c. to 9. By leading therefore that end of the chain forward, which has the least number next it, he who carries the hinder end may easily determine any number of links: thus, if he has the brass piece number 8, next to him, and 6 links more in a distance, that distance is 86 links. After the same manner 10 may be counted for every large ring of a chain which has not brass pieces on it; and the number of links is thus readily determined.

The two-pole chain has a large ring at every 10 links, and in its middle, or at 25 links, there are 2 large rings; so that any number of links may be the more readily counted off, as before.

The surveyor should be careful to have his chain measured before he proceeds on business, for the rings are apt to be open by frequent using it, and its length is thereby increased, so that no one can be too circumspect in this point.

In measuring a stationary distance, there is an object fixed in the extreme point of the line to be measured; this is a direction for the hinder chainman to govern the foremost one by, in order that the distance may be measured in a right line; for if the hinder chainman causes the other to cover the object, it is plain the foremost is then in a right line towards it. For this reason it is necessary to have a person that can be relied on, at the hinder end of the chain, in order to keep the foremost man in a right line; and a surveyor who has no such person, should chain himself. The inaccuracies of most surveys arise from bad chaining, that is, from straying out of the right line, as well as from other omissions of the hinder chainman: no person, therefore, should be admitted at the hinder end of the chain of whose abilities in this respect, the surveyor was not previously satisfied and convinced; since the success of the survey, in a great measure, depends on his care and skill.

In setting out to measure any stationary distance, the foreman of the chain carries with him 10 iron pegs pointed, each about 10 inches long; and when he has stretched the chain to its full length, he at the extremity thereof sticks one of those pegs perpendicularly in the ground; and leaving it there, he draws on the chain till the hinder man checks him when he arrives at that peg: the chain being again stretched, the foreman sticks down another peg, and the hindman takes up the former; and thus they proceed at every chain's length contained in the line to be measured, counting the surplus links contained between the last peg, and the object at the termination of the line, as before: so that the number of pegs taken up by the hinder chainman, expresses the number of chains; to which, if the odd links be annexed, the distance line required in chains and links is obtained, which must be registered in the field book, as will hereafter be shewn.

If the distance exceeds 10, 20, 30, &c. chains, when the leader's pegs are all exhausted, the hinder chainman, at the extremity of the 10 chains, delivers him all the pegs; from whence they proceed to measure as before, till the leader's pegs are again exhausted, and the hinder chainman at the extremity of these 10 chains again delivers him the pegs; from whence they proceed to measure the whole distance line in the like manner; then it is plain, that the number of pegs the hinder chainman has, being added to 10, if he had delivered all the pegs once to the leader, or to 20 if twice, or to 30 if thrice, &c. will give the number of chains in that distance; to which if the surplus links be added, the length of the stationary distance is known in chains and links.

It is customary, and indeed necessary, to have red, or other coloured cloth fixed to the top of each peg, that the hinder man at the chain may the more readily find them; otherwise, in chaining thro' corn, high grass, briars, rushes, potatoes, &c. it would be extremely difficult to find the pegs which the leader puts down: by this means no time is lost, which otherwise must be, if no cloths are fixed to the pegs, as before.

It will be necessary here to observe, that all slant or inclined surfaces, as sides of hills, are measured horizontally, and not on on the plane or surface of the hill, and is thus effected:

Let

Plate VIII. fig. 4.

Let ABC be a hill, the hindmost chainman is to hold the end of the chain perpendicularly over the point A (which he can the better effect with a plummet and line, than by letting a stone drop, which is most usual) as *d* is over A, while the leader puts down his peg at *e*: the eye can direct the horizontal position near enough, but if greater accuracy were required, a quadrant applied to the chain, would settle that. In the same manner the rest may be chained up and down: but in going down it is plain the leader of the chain must hold up the end thereof, and the plummet thence suspended, will mark the point where he is to stick his peg. The figure is sufficient to render the whole evident; and to shew that the sum of the chains will be the horizontal measure of the base of the hill; for $de = Ao$, $fg = op$, $hi = pq$, &c. therefore $de + fg + hi$, &c. $= Ao + op + pq$, &c. $= AC$, the base of the hill. If a whole chain cannot be carried horizontally, half a one, or less, may, and the sum of these half chains, or links, will give the base, as before.

If the inclined side of the hill be a plane surface, the angle of the hill's inclination may be taken, and the slant height may be measured on the surface; and thence (by case 1. of right-angled trigonometry) the horizontal line answering to the top, may be found; and if we have the angle of inclination given on the other side, with those already given; we can find the horizontal distance across the hill, by case 2. of oblique trigonometry.

All inclined surfaces are considered as horizontal ones; for all trees which grow upon any inclined surface, do not grow perpendicular thereto, but to the plane of the horizon: thus if A*d*, *ef*, *gh*, &c, were trees on the side of a hill, they grow perpendicular to the horizontal base AC, and not to the surface AB: hence the base will be capable to contain as many trees as are on the surface of the hill, which is manifest from the continuation of them thereto. And this is the reason that the area of the base of a hill, is considered to be equal in value to the hill itself.

Besides, the irregularities of the surfaces of hills in general are such, that they would be found impossible to be determined, by the most able mathematicians. Certain regular curve surfaces have been investigated with no small pains, by the most eminent: therefore an attempt to determine in general the infinity of irregular surfaces which offer themselves to our view, to any degree of certainty, would be idle and ridiculous, and for this reason also, the horizontal area is only attempted.

Again, if the circumjacent lands of a hill be planned or mapped, it is evident we shall have a plan of the hill's base in the middle: but were it possible to put the hill's surface in lieu thereof, it would extend itself into the circumjacent lands, and render the whole an heap of confusion: so that if the surfaces of hills could be determined, no more than the base could be mapped.

Roads are usually measured by a wheel for that purpose, to which there is fixed a machine, at the end whereof there is a spring, which is struck by a peg in the wheel, once in every rotation; by this means the number of rotations is known.

If such a wheel were 3 feet 4 inches in diameter, one rotation would be $10\frac{1}{2}$ feet, which is half a plantation perch; and because 320 perches make a mile, therefore 640 rotations will be a mile also: and the machinery is so contrived, that by means of a hand, which is carried round by the work, it points out the miles, quarters, and perches, or sometimes the miles, furlongs, and perches.

Or roads may be measured by a chain more accurately; for 80 four-pole, 160 two-pole chains, or 320 perches, make a mile as before: and if roads are measured by a statute chain, it will give you the miles English, but if by a plantation chain, the miles will be Irish. Hence an English mile contains 1760, and an Irish mile 2240 yards; and because 14 half yards is an Irish, and 11 half yards is an English perch, therefore 11 Irish perches, or Irish miles, are equal to 14 English ones.

Since some surveys are taken by a four-pole, and others by a two-pole chain; and as ground for houses is measured by feet, we will shew how to reduce one to the other, in the following problems.

PROB. I.

To reduce two-pole chains and links to four-pole ones.

If the number of chains be even, the half of them will be the four-pole ones, to which annex the links given, thus,

Ch. L.
1. In 16. 37 of two pole chains, how many four-pole ones?

Ch. L.
Answer 8. 37.

But if the number of chains be odd, take the half of them for chains, and add 50 to the links, and they will be four-pole chains, and links, thus,

Ch. L.
2. In 17. 42 of two-pole chains, how many four-pole ones?

Ch. L.
Answer 8. 92.

PROB. II.

To reduce four-pole chains and links, to two-pole ones.

Double the chains, to which annex the links, if they be less than 50; but if they exceed 50, double the chains, add 1 to them, and take 50 from the links, and the remainder will be the links, thus,

Ch. L.
1. In, 8. 37 of four-pole chains, how many
2 two pole ones?

16 37

2. In

Ch. L.
2. In 8. 82 of four-pole chains, how many
2. 50 two-pole ones?

17. 32 Answer.

PROB. III.

To reduce four-pole chains and links, to perches and decimals of a perch.

The links of a four-pole chain are decimal parts of it, each link being the hundredth part of a chain; therefore if the chains and links be multiplied by 4 (for 4 perches are a chain) the product will be the perches and decimal parts of a perch. Thus,

Ch. L.
How many perches in 13. 64 of four-pole chains?
4

Answer 54. 56 perches.

PROB. IV.

To reduce two-pole chains and links, to perches and decimals of a perch.

They may be reduced to four-pole ones (by prob. 1.) and thence to perches and decimals (by the last.) or, If the links be multiplied by 4, carrying one to the chains, when the links are, or exceed 25; and the chains by 2 adding one, if occasion be: the product will be perches, and decimals of a perch. Thus,

Ch. L.
1. In 17. 21 of two pole chains, how many
2. 4 perches?

Answer 34. 84 perches.

Ch. L.
2. In 15. 38. of two-pole chains, how many
2. 4 perches?

Answer 31. 52 perches.

PROB. V.

To reduce perches, and decimals of a perch, to four-pole-chains and links.

Divide by 4, so as to have two decimal places in the quotient, and that will be four-pole chains and links. Thus,

In 31. 52 perches, how many four pole chains and links.

Ch. L.
4)31.52(7. 88 Answer.
35
32

PROB.

PROB. VI.

To reduce perches and decimals of a perch, to two-pole chains and links.

The perches may be reduced to four-pole chains (by the last) and from thence to two-pole chains (by prob. 2.) or,

Divide the whole number by 2, the quotient will be chains; to the remainder annex the given decimals, and divide by 4, the last quotient will be the links, Thus,

In 31.52 perches, how many two-pole chains and links?

```
          Ch.  L.
2)31.52(15.  38 Answer.
  -----
   11
  -----
  4)152(38
   ----
    32
   ----
```

PROB. VII.

To reduce chains and links to feet and decimal parts of a foot.

If they be two-pole chains, reduce them to four-pole ones: (by prob. 1.) these being multiplied by the feet in a four-pole chain, will give the feet, and decimals of a foot. Thus,

Ch. L.
In 17. 21 of two pole chains, how many feet?

Ch. L.
8. 71 of four-pole chains.
66 feet = 1 chain.

5226. Feet. Inches.
5226 Answer 574. $10\frac{1}{4}$.

Feet 574.86
12

Inches 10,32
4

1.28

PROB. VIII.

To reduce feet and inches to chains and links.

Reduce the inches to the decimal of a foot,* and annex that to the feet; that divided by the feet in a four-pole chain, will give four-pole chains and links in the quotient: these may be reduced to two-pole chains and links, if required, by prob. 2. Thus,

Feet. Inches.
In 217. 9 how many two-pole chains?

12)9.00(,75 the decimal of nine inches.
60

66)

66)217.75(3. 29 of four-pole chains, or

197
Ch. L.
655 6. 29 of two pole chains,

61

How to take a Survey by the CHAIN *only.*

PROB. I.

To survey a piece of ground, by going round it, and the method of taking the angles of the field, by the chain only,

Plate VI, fig. 6,

Let ABCDEFG be a piece of ground to be surveyed: beginning at the point A, let one chain be laid in a direct line from A towards G, where let a peg be left, as at *c*; and again the like distance from A in a direct line towards B, where another peg is also to be left, as at *d*: let the distance from *d* to *c* be measured, and placed in the field-book, in the second column under the denomination of angles, in a line with station No. 1; and in the same line under the title of distances, in the third column, let the measure of the line AB in chains and links be inserted. Being now arrived at B, let one chain be laid in a direct line from B towards A, where let a peg be left, as at *f*, and again, the like distance from B in a direct line towards C, where let also another peg be left, as at *e*; the distance from *e* to *f* is to be inserted in the field-book, in the second column, under angles, in a line with station No. 2.; and in the same line, under the title of distances in the third column, let the measure of the line BC, in chains and links, be inserted: after the same manner we may proceed from C to D, and thence to E; but because the angle at E, *viz.* FED, is an external angle, after having laid one chain from E to *h*, and to *g*, the distance from *g* to *h* is measured, and inserted in the column of angles, in a line with station No. 5. and on the side of the field-book against that station, we make an asterisk, thus *, or any other mark, to signify that to be an external angle, or one measured out of the ground. Proceed we then as before, from E to F, to G, and thence to A, measuring the angles and distances, and placing them as before, in the field-book, opposite to their respective stations; so will the field book be completed in manner following.

N. B. After this manner the angles for inaccessible distances may be taken, and the method of constructing or laying them down, as well as the construction of the map, from the following field-notes, must be obvious from the method of taking them.

The form of the field-book, with the title.

A field-book of part of the land of Grange, in the parish of Portmarnock, barony of Coolock, and county of Dublin; being part of the estate of L. P. esq. let to C. D. farmer. Surveyed January 30, 1807.

Taken by a four-pole chain.

Remarks.	No. Sta.	Angles Ch. L.	Diſtances. Ch. L.
Mr. J. D's part of Grange	1	1.80	17.65
	2	1.79	18.50
Mr. L. P's part of Portmarnock	3	1.76	28.00
strand	4	1.41½	20.00
*	5	1.87½	14.83
Widow J. G's part of Grange	6	1.14	19.41
	7	1.89	24.53
	Cloſe at the firſt ſtation.		

The signification of the remarks.

Mr. J. D's part of Grange bounds, or is adjacent to the surveyed land from the first to the third station: Mr. L. P's part of Portmarnock bounds it from the third to the fourth station; the strand then is the boundary from thence to the sixth, and from the sixth to the first station, the widow J. G's part of Grange is the boundary.

It is absolutely necessary to insert the persons' names, and town-lands, strands, rivers, bogs, rivulets, *&c.* which bound or circumscribe the land which is surveyed, for these must be expressed in the map.

In a survey of a town land, or estate, it is sufficient to mention only the circumjacent town-lands, without the occupiers' names; but when a part only of a town land is surveyed, then it is necessary to insert the person or persons' names, who hold any particular parcel or parcels of such town-land, as bound the parts surveyed.

When an angle is very obtuse, as most in our present figure are, *viz.* the angles at A, B, C, E, and G; it will be best to lay a chain from the angular point as at A, on each of the containing sides to *c* and to *d*; and any where nearly in the middle of the angle, as at *e*: measuring the distances *ce* and *ed*; and these may be placed for the angle in the field book. Thus,

No.	Sta.	Angle. Ch. L.	Dist. Ch. L.
1		1.03 1.09	17.65

For when an angle is very obtuse, the chord line, as *cd* will be nearly equal to the radii A*c* and A*d*; so if the arc *ced* be swept, and the chord line *cd*, be laid on it, it will be difficult to determine exactly that point in the arc where *cd* cuts it: but if the angle be taken in two parts, as *ce* and *ed*; such chords may with safety be laid on the arc, and the angle thence may be truly determined and constructed.

After the same manner any piece of ground may be surveyed by a two-pole chain.

PROB. II.

To take a survey of a piece of ground from any point within it, from whence all the angles can be seen; by the chain only.

Let

Plate VI. fig. 6.

Let a mark be fixed at any point in the ground, as at H, from whence all the angles can be seen; let the measures of the lines HA, HB, HC, &c. be taken to every angle of the field from the point H; and let those be placed opposite to No. 1, 2, 3, 4, &c. in the second column of radii: the measures of the respective lines of the mearing, *viz.* AB, BC, CD, DE, &c. being placed in the third column of distances, will complete the field-book. Thus,

Remarks.	No.	Radii. Ch. L.	Diſtances. Ch. L.
	1	20.00	17.65
	2	21.72	18.50
	3	21.74	28.00
	4	25.34	20.00
	5	17.20	14.83
	6	29.62	19.41
	7	21.20	24.53
	Cloſe at the firſt ſtation.		

If any line of the field be inaccessible, as suppose CD to be, then by way of proof that the distance CD is true, let the measure of the angle CHD be taken by the line *oo*, with the chain: if this angle corresponds with its containing sides, the length of the line DC is truly obtained, and the whole work is truly taken.

Note. That in setting off an angle, it is necessary to use the largest scale of equal parts, *viz.*

that of the inch, which is diagonally divided into 100 parts, in order that the angle should be accurately laid down; or if two inches were thus divided for angles, it would be the more exact; for it is by no means necessary that the angles should be laid from the side scale with the stationary distances.

PROB. III.

To take a survey by the chain only, when all the angles cannot be seen from one point within.

Plate VI. fig. 7.

Let the ground to be surveyed be represented by 1, 2, 3, 4, *&c.* Since all the angles cannot be seen from one point, let us assume 3 points, as A, B, C, from whence they may be seen: at each of which let a mark be put, and the respective sides of the triangle be measured and set down in the field-book; let the distances from A to 1, and from B to 1, be measured, and these will determine the point 1; let the other lines which flow from A, B, C, as well as the circuit of the ground, be then measured as the figure directs; and thence the map may be easily constructed.

There are other methods which may be used; as dividing the ground into triangles, and measuring the 3 sides of each; or by measuring the base and perpendicular of each triangle. But this we shall speak of hereafter.

PROB. IV.

How to take any inaccessible distance by the chain only.

Plate VIII. fig. 8.

Suppose AB to be the breadth of a river, or any other inaccessible distance, which may be required.

Let a staff or any other object be set at B, draw yourself backward to any convenient distance C, so that B may cover A: from B, lay off any other distance by the river's side to E, and complete the parallelogram EBCD: stand at D, and cause a mark to be set at F, in the direction of A; measure the distance in links from E to F, and FB will be also given. Wherefore EF : ED :: FB : AB. Since it is plain (from part 2. theo. 3. sect. 1. and theo. 2. sect. 1.) the triangles EFD BFA, are mutually equi-angular.

If part of the chain be drawn from B to C, and the other part from B to E; and if the ends at E and C be kept fast, it will be easy to turn the chain over to D, so as to complete a parallelogram; by reckoning off the same number of links you had in BC, from E to D, and pulling each part straight.

OF THE

CIRCUMFERENTOR.

THIS instrument is composed of a brass circular box, about five or six inches in diameter within which is a brass ring, divided on the top; into 360 degrees, and numbered 10, 20, 30, *&c.* to 360: in the centre of the box is fixed a steel pin finely pointed, called a center-pin on which is placed a needle touched with a load stone, which always retains the same situation; that is, it always points to the North and South points of the horizon nearly, when the instrument is horizontal, and the needle at rest.

The box is covered with a glass lid, in a brass rim to prevent the needle being disturbed by wind or rain, at the time of surveying: there is also a brass lid or cover, which is laid over the former to preserve the glass in carrying the instrument.

This box is fixed by screws, to a brass index, or ruler, of about 14 or 15 inches in length, to the ends whereof are fixed brass sights, which are screwed to the index, and stand perpendicular thereto: in each sight is a large and a small aperture or slit, one over the other; but these are changed, that is, if the large aperture be uppermost in the one sight, it will be lowest in the other, and so of the small ones: therefore the small aperture in one is opposite to the large one in the other; in the middle of which last, there is placed a horse hair, or fine silk thread.

The instrument is then fixed on a ball and socket; by the help of which and a screw, you can readily fix it horizontally in any given direction; the socket being fixed on the head of a three-legged staff, whose legs when extended, support the instrument, whilst it is used.

How to take field notes by the circumferentor.

Plate VI. fig. 6.

Let your instrument be fixed at any angle, as A, your first station; and let a person stand at the next angle B, or cause a staff, with a white sheet to be set there perpendicularly for an object to take your view to: then having placed your instrument horizontally (which is easily done by turning the box so, that the ends of the needle may be equidistant from its bottom, and it traverses or plays freely) turn the flower-de-luce or north part of the box to your eye, and looking through the small aperture, turn the index about, till you cut the person or object in the next angle B, with the horse hair, or thread of the opposite sight: the degrees then cut by the south end of the needle, will give the number to be placed in the second column of your field-book in a line with station No. 1, and expresses the number of degrees the stationary line is from the north, counting quite round with the sun.

Most needles are pointed at the south end, and have a small ring at the north: such needles are better than those which are pointed at each end, because the surveyor cannot mistake by counting to a wrong end; which error may be frequently committed, in using a two-pointed needle.

Two-pointed needles have sometimes a ring, but more usually a cross towards the north end: and the south end is generally bearded towards its extremity, and some times not, but its arm is a naked right line from the cap at the centre.

Having taken the degrees or bearing of the first stationary line AB, let the line be measured, and the length thereof in chains and links be inserted in the third column of your field-book, under the title of distances, opposite to station No. 1.

It is customary, and even neceſsary, to cause a sod to be dug up at each station, or place where you fix the instrument: to the end, that if any error should arise in the field-book, it may be the more readily adjusted and corrected, by trying over the former bearings and stationary distances.

Having done with your first station, set the instrument over the hole or spot where your object stood, as at B, for your second station, and send him forward to the next angle of the field, as at C; and having placed the instrument in an horizontal direction, with the sights directed to the object at C, and the north of the box next your eye, count your degrees to the south end of the needle, which register in your field-book, in the second column opposite to station No. 2; then measure the stationary distance BC, which insert in the third column, and thus proceed from angle to angle, sending your object before you, till you return to the place where you began, and you will have the field-book complete; observing always to signify the parties names who hold the contiguous lands, and the names of the town-lands, rivers, roads, swamps, lakes, &c. that bound the land you survey, as before: and this is the manner of taking field-notes by what are called fore-sights.

But the generality of mearsmen frequently set themselves in disadvantageous places, so as often to occasion two or more stations to be made, where one may do, which creates much trouble and loss of time: we will therefore show how this may be remedied, by taking back-sights, thus: let your object stand at the point where you begin your survey, as at A; leaving him there, proceed to your next angle B, where fix your instrument so that you may have the longest view possible towards C. Having set the instrument in an horizontal position, turn the south part of the box next your eye, and having cut your object at A, reckon the degrees to the south point of the needle, which will be the same as if they were taken from the object to the instrument, the direction of the index being the same. Let the degree be inserted in the field-book, and the stationary distance be measured and annexed thereto, in its proper column; and thus proceed from station to station, leaving your object in the last point you left, till you return to the first station A.

By this method your stations are laid out to the best advantage, and two men may do the business of three, for one of those who chain, may be your object; but in fore-sights, you must have an object before you, besides two chainmen.

It was said before, that a surveyor should have a person with him to carry the hinder end of the chain, on whom he can depend: this person should be expert and ready at taking off-sets, as well as exact in giving a faithful return of the length of every stationary line. One who has such a person, and who uses back-sights, will be able to go over near double the ground he could in the same time, by taking fore-sights. But if the surveyor has no such person on whom he can with safety depend, he must take fore-sights, because of overseeing the chaining; for should he take back-sights, he must be obliged, after taking his degree, to go back to the foregoing station, to oversee the chaining, and by this means to walk three times over every line, which is a slavery not to be borne.

Or a back and a fore-sight may be taken at one station, thus; with the south of the box to your eye, observe from B the object A, and set down the degree in your field-book, cut by the south end of the needle. Again, from B observe an object at C, with the north of the box to your eye, and set down the degree cut by the south point of the needle, so have you the bearings of the lines AB and BC; you may then set up your instrument at D, from whence take a back-sight to C, and a fore-sight to E; thus the bearings may be taken quite round, and the stationary distances being annexed to them, will complete the the field-book.

But in this last method, care must be taken to see that the sights have not the least cast on either side; if they have, it will destroy all: and yet with the same sights you may take a survey by fore-sights, or by back-sights only, with as great truth as if the sights were ever so erect, provided the same cast continues without any alteration; but upon the whole, back sights only will be found the readiest method.

If your needle be pointed at each end, in taking fore-sights, you may turn the north part of the box to your eye, and count your degrees to the south part of the needle, as before; or you may turn the south of the box to your eye, and count your degrees to the north end of the needle.

But in back-sights you may turn the north of the box to your eye, and count your degrees to the north point of the needle; or you may turn the south of the box to your eye, and count your degrees to the south end of the needle.

The brass ring in the box is divided on the side into 360 degrees, thus; from the north to the east into 90, from the north to the west into 90, from the south to the east into 90, and from the south to the west into 90 degrees; so the degrees are numbered from the north to the east or west, and from the south to the east or west.

The manner of using this part of the instrument is this; having directed your sights to the object, whether fore or back, as before; observe the two cardinal points of your compass the point of the needle lies between (the north, south, east, and west, being called the four cardinal points, and are graved on the bottom of the box) putting down those points together by their initial letters, and thereto annexing the number of degrees, counting from the north or south, as before, thus; if the point of your needle lies between the north and east, north and west, south and east, or south and west points in the bottom of the box, then put down NE, NW, SE, or SW, annexing thereto the number of degrees cut by the needle on the side of the ring, counting from the north or south, as before.

But if the needle point exactly to the north, south, east, or west, you are then to write down N, S, E, or W, without annexing any degrees.

This is the manner of taking field-notes, whereby the content of ground may be universally determined by calculation; and they are said to be taken by the quartered compass, or by the four nineties.

To find the number of degrees contained in any given angle.

Set up your instrument at the angular point, and thence direct the sights along each leg of the angle, and note down their respective bearings, as before; the difference of these bearings, if less than 180, will be the quantity of degrees contained in the given angle; but if more, take it from 360, and the remainder will be the degrees contained in the given angle.

OF THE

THEODOLITE,

THIS instrument is a circle, commonly of brass, of ten or twelve inches in diameter, whose limb is divided into 360 degrees, and those again are subdivided into smaller parts as the magnitude of it will admit; sometimes by equal divisions, and sometimes by diagonals, drawn from one concentric circle of the limb to another.

In the middle is fixed a circumferentor, with a needle; but this is of little or no use, except in finding a meridian line, or the proper situation of the land.

Over the brass circle is a pair of sights, fixed to a moveable index, which turns on the centre of the instrument, and upon which the circumferentor box is placed.

This instrument will either give the angles of the field, or the bearing of every stationary distance line, from the meridian; as the circumferentor and quartered compass do.

First then, *To take the angles of the field.*

Plate VI. fig. 6.

Lay the ends of your index to 360, and 180; turn the whole about with the 360 from you; direct the sights from A to G, and screw the instrument fast; direct them from A, to cut the object at B; the degree then cut by that end of the index which is opposite to you, will be the quantity of the angle GAB, to place in your field-book; to which annex the measure of the line AB, in chains and links; set up your instrument at B, unscrew it, and lay the ends of your index to 360 and 180; turn the whole about with the 360 from you, or 180 next you, till you cut the object at A; screw the instrument fast, and direct your sights to the object at C, and the degree then cut by that end of the index which is opposite to you, will be the quantity of the angle ABC. Thus proceed from station to station, still laying the index to 360, turning it from you, and observing the object at the foregoing station, screwing the instrument fast, and observing the object at the following station, and counting the degrees to the opposite end of the index, will give you the quantity of each respective angle.

LEMMA.

All the angles of any polygon, are equal to twice as many right angles as there are sides less by four. Thus, all the angles A, B, C, D, E, F, G, are equal to twice as many right angles as there are sides in the figure, less by four.

Plate VI. fig. 6.

Let the polygon be disposed into triangles, by lines drawn from any assigned point H within it, as by the lines HA, HB, HC, &c. It is evident then (by theo. 5. sect. 1.) that the three angles of each triangle are equal to two right; and consequently, that the angles in all the triangles are twice as many right ones as there are sides: but all the angles about the point H, are equal to four right (by cor. 2. theo. 1. sect. 1.) therefore the remaining angles are equal to twice as many right ones as there are sides in the figure, abating four. Q. E. D.

SCHOLIUM.

Hence we may know if the angles of a survey be truly taken: for if their sum be equal to twice as many right angles, as there are stations, abating four right angles, you may conclude that the angles were truly taken, otherwise not.

If you take the bearing of any line with the circumferentor, that bearing will be the number of degrees the line is from the north; consequently the north must be a like number of degrees from the line, and thus the north, and of course the south, as well as the east and west, or the situation of the land is obtained.

Secondly, *To take the bearing of each respective line from the meridian; or to perform the office of the circumferentor, or quartered compass, by the theodolite.*

Set your instrument at the first station, and lay the index to 360 and 180, with the flower-de-luce of the box next the 360; unscrew the instrument, and turn the whole about, till the north and south points of the needle cut the north and south points in the box; then screw it fast, so is the instrument north and south, abstracted of the variation.

The circumferentor box may be then taken off,

Direct the sights to the object at the second station, and the degree cut by the opposite end of the index will be the bearing of that line from the north, and the same that the circumferentor would give.

After having measured the stationary distance, set up your instrument at the second station; unscrew it, and set either end of the index to the degree of the last line, and turning the whole about with that degree towards you, direct your sights to an object at the foregoing station, and screw the instrument fast; it will then be parallel to its former situation, and consequently north and south; direct then your sights to an object at the following station, and the degree cut by the opposite end of the index, will be the bearing of that line.

In like manner you may proceed thro' the whole.

If the brass circle be divided into four nineties, from 360 and 180, and the letters, N, S, E, W, be applied to them; the bearings may be obtained by putting down the letters the far or opposite end of the index lies between, and annexing thereto the degrees from the N or S; and this is the same as the quartered compass.

If you keep the compass box on, to see the mutual agreement of the two intruments; after having fixed the theodolite north and south, as before; turn the index about with the north end or flower-de-luce next your eye, and count the degree to the opposite, or south end of the index, and this will correspond with the degree cut by the south end of the needle.

At the second, or next station, unscrew the instrument, and set the south of the index to the degree of the last station; turn the whole about, with the south of the index to you, and cut the object at the foregoing station; screw the instrument fast, and with the north of the index to you, cut the object at the next following station, the degree then cut by the south of the index, will correspond with the degree cut by the south end of the needle, and so through the whole.

Some theodolites have a standing pair of sights fixed at 360 and 180, besides those on the moveable index: if you would use both, look through the standing sights, with the 180 next you, to an object at the foregoing station: screw the instrument fast, and direct the upper sights on the moveable index, to the object at the following station, and the degree cut by the opposite end of the index, will give you the quantity of the angle of the field.

Two pair of sights can be of no use in finding the angles from the meridian; and inasmuch as one pair is sufficient to find the angles of the field, the second can be of no use: besides, they obstruct the free motion of the moveable index, and therefore are rather an incumbrance than of any real use. Some will have it, that they are useful with the others, for setting off a right angle, in taking an off-set: and surely this is as easily performed by the one pair on the moveable index: thus, if you lay the index to 360 and 180, and cut the object either in the last or following station, screw the instrument fast, and turn the index to 90 and 270, and then it will be at right angles with the line. So that the small sights, or those of the circle, can be of no additional use to the instrument, and therefore should be laid aside as useless.

This instrument may be used in windy and rainy weather, as well as in mountainous and hilly grounds; for it does not require an horizontal position to find the bearing, or angle, as the needle doth; and therefore is preferred to any instrument that is governed by the needle.

OF THE

SEMICIRCLE.

THIS instrument as its name imports, is a half circle, divided from its diameter into 180 degrees, and from thence again, that is, from 0, to 360: it is generally made of brass, and is from 8 to 16 inches diameter.

On the centre there is a moveable index, with sights, on which is placed a circumferentor-box, as in the theodolite.

This instrument may be used as the theodolite in all respects; but with this difference, when you are to reckon the degree to that end of the index which is off of the semicircle, you may find it at the other end, reckoning the degree from 180 forwards.

OF THE

PLANE TABLE.

A PLANE TABLE is an oblong of oak, or other wood, about 15 inches long, and 12 broad; they are generally composed of 3 boards which are easily taken asunder, or put together, for the convenience of carriage.

There is a box frame, with 6 joints in it, to take off and put on as occasion serves; it keeps the table together, and is likewise of use to keep down a sheet of paper which is put thereon.

The outside of the frame is divided into inches and tenths, which serve for ruling parallels or squares on the paper, or for shifting it, when occasion serves.

The inside of the frame is divided into 360 degrees, which though unequal on it, yet are the degrees of a circle produced from its centre, or centre of the table, where there is a small hole.

The degrees are subdivided as small as their distance will admit; at every tenth degree are two numbers, one the number of degrees, the other its complement to 360.

There is another centre hole, about $\frac{1}{4}$ of the table's breadth from one edge, and is in the middle between the two ends. To this centre hole on the other side of the frame, there are the divisions of a semicircle, or 180 degrees; and these again are subdivided into halves, or quarters, as the size of the instrument will admit.

That side of the frame on which the 360 degrees are, supplies the place of a theodolite, the other that of a semicircle.

There is a circumferentor-box of wood, with a paper chart at the bottom applied to one side of the table by a dove tail joint, fastened by a screw. This box (besides its rendering the plane table capable of answering the end of a circumferentor) is very useful for placing the instrument in the same position every remove.

There is a brass ruler or index, of about two inches broad, with a sharp or fiducial edge, at each end of which is a sight; on the ruler are scales of equal parts, with and without diagonals, and a scale of chords; the whole is fixed on a ball and socket, and set on a three-legged staff.

To take the angles of a field by the table.

Having placed the instrument at the first station, turn it about till the north end of the needle be over the meridian, or flower-de-luce of the box, and there screw it fast. Assign any convenient point, to which apply the edge of the index, so as through the sights you may see the object in the last station, and by the edge of the index from the point draw a line. Again, turn about the index with its edge to the same point, and through the sights observe the object in the second station, and from the point, by the edge of the index, draw another line; so is the angle laid down; on that last line set off the distance to the second station, in chains and links: apply your instrument to the second station, taking the angle as before; and after the like manner proceed till the whole is finished.

This method may be used in good weather, if the needle be well touched and play freely; but if it be in windy weather, or the needle out of order, it is better, after having taken the first angle as before, and having removed your instrument to the second station, and placed the needle over the meridian line as before, to lay the index on the last drawn line, and look backward thro' the sights; if you then see the object in the first station, the table is fixed right, and the needle is true; if not, turn the table about, the index lying on the last line, till through the sights you see the object in the first station; and then screw it fast, and keeping the edge of the index to the second station, direct your sights to the next; draw a line by the edge of the index, and lay off the next line; and proceed through the whole without using the needle, as you do with the theodolite.

If the sheet of paper on the table be not large enough to contain the map of the ground you survey, you must put on a clean sheet, when the other is full; and this is called shifting of paper, and is thus performed.

Plate VI. fig. 8.

Let ABCD represent the sheet of paper on the plane table, upon which the plot E, F, G, H, I, K, L, M, is to be drawn; let the first station be E, proceed as before from thence to F, and to G; then proceeding to H, you find there is not room on your paper for the line GH; however, draw as much of the line GH, as the paper can hold, or draw it to the paper's edge. Move your instrument back to the first station E, and proceed the contrary way to M, and to L; but in going from thence to K, you again find your sheet will not hold it; however, draw as much of the line LK on the sheet as it can hold.

Take that sheet off the table, first observing the distance *oo* of the lines GH and LK, by the edge of the table; take off that sheet, and mark it with No. 1, to signify it to be the first taken off. Having then put on another sheet, lay that distance *oo* on the contrary end of the table, and so proceed as before, with the residue of the survey, from *o* to H, to K, and thence to *o*; so is your survey complete.

In the like manner you may proceed to take off, and put on, as many sheets as are convenient; and these may afterwards be joined together with mouth glue, or fine white wafer very thin.

If the index be fixed to the first centre, using the 360 side, it will then serve as a theodolite, and when to the second centre, using the 180 side, it will serve as a semicircle; by either of which you may survey in rainy weather, when you cannot have paper on the table.

To take an Angle of Altitude by the Circumferentor, Theodolite, Semicircle, or Plane Table.

1. *To take an angle of altitude, by the circumrentor.*

LET the glass lid be taken off, and let the instrument be turned on one side, with the stem of the ball into the notch of the socket, so that the circle may be perpendicular to the plane of the horizon; let the instrument be placed in this situation before the object, so that the top thereof may be seen through the sights; let a plummet be suspended from the centre pin, and the object being then observed, the complement of the number of degrees, comprehended between the thread of the plummet, and that part of the instrument which is next your eye, will give the angle of altitude required.

2. If an angle of altitude is to be taken by the theodolite, or semicircle, let a thread be run through a hole at the centre, and a plummet be suspended by it; turn the instrument on one side, by the help of the ball and notch in the socket for that purpose, so that the thread may cut 90, having 360 degrees next you; screw it fast in that position, and through the sights cut the top of the

objects; and the degrees then cut by the end of the index next you, are the degrees of elevation required. An angle of depression is taken the contrary way.

3. By the plane table an angle of altitude is taken in the like manner, by suspending a plummet from the centre thereof, having turned the table on one side, and fixed the index to the centre by a screw, so as to move freely, let the thread cut 90, look through the sights as before, and you have the angle of elevation, and on the contrary that of depression.

OF THE

PROTRACTOR.

THE protractor is a semicircle annexed to a scale, and is made of brass, ivory, or horn; its diameter is generally about five or six inches.

The semicircle contains three concentric semicircles at such distances from each other, that the spaces between them may contain figures.

The outward circle is numbered from the right to the left hand, with 10, 20, 30, &c, to 180 degrees; the middlemost the same way, from 180 to 360 degrees; and the innermost, from the upper edge of the scale both ways, from 10, 20, 30, &c. to 90 degrees.

It is easy to conceive that the protractor, tho' a semicircle, may be made to supply the place of a whole circle; for if a line be drawn, and the centre-hole of the protractor be laid on any point in that line, the upper edge of the scale corresponding with that line, the divisions on the edge of the semicircle will run from 0 to 180, from right to left: again, if it be turned the other way, or downwards, keeping the centre-hole thereof on the aforesaid point in the line, then the divisions will run from 180 to 360, and so completes an entire circle with the former semicircle.

The use of the protractor is to lay off angles, and to delineate or draw a map, or plan, of any ground from the field-notes; and is performed in the following manner.

To protract a field-book, when the angles are taken from the meridian.

Plate VI. fig. 9.

On your paper, rule lines parallel to each other, at an inch asunder (being most usual) or at any other convenient distance; on the left end of the parallels put N. for north, and on the right S. for south; put E. at the top for east, and W. at the bottom of your paper for west.

Then let the following field-book be that which is to be protracted, the bearings being taken from the meridian, whether by a circumferentor, theodolite, or semicircle, and measured with a two-pole chain.

No.	Bearing.	Ch. L.
1	$283\frac{1}{2}$	55.20
2	$348\frac{3}{4}$	12.36
3	317	29.20
4	266	55.20
5	193	40.00
6	124	76.00
7	$63\frac{3}{4}$	87.02

Cloſe at the firſt ſtation.

Pitch upon any convenient point on your paper, for your first station, as at 1, on which lay the centre-hole of your protractor, with a protracting-pin; then if the degrees be less than 180, turn the arc of your protractor downwards, or towards the west; but if more than 180, upwards, or towards the east.

Or if the right hand be made the north, and the left the south, the west will be then up, and the east down.

In this case, if the degrees be less than 180, turn the arc of your protractor upwards, or towards the west; and if more, downwards, or towards the east.

By the foregoing field-book, the first bearing is 283½; turn the arc of your protractor upwards, keeping the pin in the centre-hole, move the protractor so that the parallel lines may cut opposite divisions, either on the ends of the scale, or on the degrees, and then it is parallel. This must be always first done, before you lay off your degrees.

Then by the edge of the semicircle keeping the protractor steady, with the pin prick the first bearing 283½, and from the centre-point, thro' that point or prick, draw a blank line with the pin, on which from a scale of equal parts, or from the scale's edge of the protractor, lay off the distance 55C. 20L. so is that station protracted.

At the end of the first station, or at 2, which is the beginning of the second, with the pin place the centre of the protractor, turning the arc up, because the bearing of the second station is more than 180, *viz.* 348$\frac{3}{4}$. Place your protractor parallel as before, and by the edge of the semicircle, with the pin prick at that degree, thro' which and the end of the foregoing station, draw a blank line, and on it set the distance of that station.

In the like manner proceed thro' the whole, only observe to turn the arc of your protractor down, when the degrees are less than 180.

If you lay off the stationary distances by the edge of the protractor, it is necessary to observe, that if your map is to be laid down by a scale of 40 perches to an inch, every division on the protractor's edge will be one two-pole chain; $\frac{1}{2}$ a division will be 25 links, and $\frac{1}{4}$ of a division will be 12$\frac{1}{2}$ links.

If your map is to be laid down by a scale of 20 perches to an inch, two divisions will be one two-pole chain; one division will be 25 links; $\frac{1}{2}$ a division 12$\frac{1}{2}$ links, and $\frac{1}{4}$ of a division will be 6$\frac{1}{4}$ links.

In the general, if 25 links be multiplied by the number of perches to an inch, the map is to be laid down by, and the product be divided by 20 (or which is the same thing, if you cut off one and take the half) you will have the value of one division on the protractor's edge, in links and parts.

EXAMPLE.

EXAMPLE.

1. How many links in a division, if a map be laid down by a scale of 8 perches to an inch?

25
8

2|0)20|0

10 links. Answer.

2. How many links in a division, if a map be laid down by a scale of 10 perches to an inch?

25
10

2|0)25|0

12.5 or 12$\frac{1}{2}$ links. Answer.

And so of any other.

To protract a field-book, taken by the angles of the field.

Note, We here suppose the land surveyed is kept on the right hand as you survey.

Draw a blank line with a ruler of a length greater than the diameter of the protractor; pitch upon any convenient point therein, to which apply the centre-hole of your protractor with your pin, turning the arc upwards if the angle be less than 180, and downwards if more; and observe to keep the upper edge of the scale, or 180 and 0 degrees upon the line; then prick off the number of degrees contained in the given angle and draw a line from the first point through the point at the degrees; upon which lay the stationary distance. Let this line be lengthened forwards and backwards, keeping your first station to the right, and second to the left; and lay the centre of your protractor over the second station, with your pin, turning the arc upwards, if the angle be less than 180, and downwards, if more; and keeping the 180 and 0 degrees on the line, prick off the number of degrees contained in the given angle, and thro' that point and the last station draw a line, on which lay the stationary distance: and in like manner proceed through the whole.

In all protractions, if the end of the last station falls exactly in the point you began at, the field-work and protraction are truly taken, and performed; if not, an error must have been committed in one of them; in such case make a second protraction; if this agrees with the former, and neither meet or close, the fault is in the field-work, and not in the protraction; and then a re-survey must be taken,

SECT. IV.

Containing two Methods by which the Areas of right-lined Figures may be determined.

DEFINITION.

THE area or content of any plane surface in perches, is the number of square perches that surface contains.

Plate VII. fig. 1.

Let ABCD represent a rectangular parallelogram or oblong; let the side AB, or DC, contain 8 equal parts; and the side AD, or BC, three of such parts; let the line AB be moved in the direction of AD, till it has come to EF; where AE, or BF (the distance of it from its first situation) may be equal to one of the equal parts. Here it is evident, that the generated oblong ABEF, will contain as many squares as the side AB contains equal parts, which are 8; each square having for its side one of the equal parts, into which AB, or AD, is divided. Again let AB move on till it comes to GH, so as GE, or HF, may be equal to AE, or BF; then it is plain that the oblong AGHB, will contain twice as many squares as the side AB contains equal parts. After the same manner it will appear, that the oblong ADCB will contain three times as many squares as the side AB contains equal parts; and in general, that every rectangular parallelogram, whether square or oblong, contains as many squares as the product of the number of equal parts in the base, multiplied into the number of the same equal parts in the height, contains units, each square having for its side one of the equal parts.

Hence arises the solution of the following problems.

PROB. I.

To find the content of a square piece of ground.

1. Multiply the base in perches, into the perpendicular in perches (or square the base) the product will be the content in perches; and because 160 perches make an acre, it must thence follow, that

Any area, or content in perches, being divided by 160, will give the content in acres; the remaining perches, if more than 40, being divided by 40, will give the roods, and the last remainder, if any, will be perches.

Or, thus:

2. Square the side in four-pole chains and links, and the product will be square four-pole chains and links; divide this by 10, or cut off one more than the decimals, which are five in all from the right towards the left; the figures

resting to the left are acres, because 10 square four-pole chains make an acre, and the remaining figures are decimal parts of an acre. Multiply the five figures to the right by 4, cutting 5 figures from the product, and if any figure be to the left of them, it is a rood, or roods; multiply the last cut off figures by 40, cutting off five or (which is the same thing) by 4, cutting off four; and the remaining figures to the left, if any, are perches.

1. The first part is plain, from considering that a piece of ground in a square form, whose side is a perch, must contain a perch of ground; and that 40 such perches make a rood, or stang, and four roods an acre; or which is the same thing, that 160 square perches make an acre as before.

2. A square four-pole chain (that is a piece of ground four-poles or perches every way) must contain 16 square perches; and since 160 perches make an acre, therefore 10 times 16 perches, or 10 square four-pole chains make an acre.

Note, That the chains given or required, in any of the following problems, are supposed two-pole chains that chain being most commonly used; but they must be reduced to four-pole chains or perches for calculation, because the links will not operate with them as decimals.

EXAMPLES.

Plate I. fig. 17.

Ch. L.

Let ABCD be a square field, whose side is 14. 29; I demand the content in acres.

By

Ch.L.
By problem 4. section 3. 14.29 are equal to
29.16 perches.
29.16

17496
2916
26244
5832

A. R. P.
160)850.3056(5. 1. 10. content.

40)50(1 rood.

10 perches.

Or, thus:

Ch. L. Ch. L.
14.29 are equal to 7. 29 of four-pole chains, by prob. 1. sect. 3. 7. 29

6561
1458
5103

A. R. P.
Acres 5|31441 content as before 5. 1. 10.
4

Rood 1|25764
4

Perches 10|3056

It is required to lay down a map of this piece of ground, by a scale of twenty perches to an inch.

Take 29.16 the perches of the given side, from the small diagonal on the common surveying scale, where 20 small, or two of the large divisions are an inch; make a square whose side is that length (by prob. 9. sect. 1.) and it is done.

PROB. II.

To find the side of a square, whose content is given.

Extract the square root of the given content in perches, and you have the side in perches, and consequently in chains.

EXAMPLE.

It is required to lay out a square piece of ground which shall contain 12A. 3R. 16P. Required the number of chains in each side of the square; and to lay down a map of it, by a scale of 40 perches to an inch.

```
        A.  R.  P.
        12. 3.  16.
         4
       ——
        51
        40
       ——                    Ch.  L.
       2056(45.34 perches=22. 33½, by prob. 6.
       ——                  [sect. 3.
    85)456
    ——
    903)3100
        ——
    9064(39100
        ——
```

To draw the map.

From a scale where 4 of the large, or 40 of the small divisions are an inch, take 45.34, the perches of the side, of which make a square.

PROB. III.

To find the content of an oblong piece of ground.

Multiply the length by the breadth, for the content.

EXAMPLE.

Plate I. fig. 3.

Let ABCD be an oblong piece of ground, whose length AB is 14C. 25L. and breadth 8C. 37L. I demand the content in acres, and also to lay down a map of it, by a scale of 20 perches to an inch.

Ch. L. Perches.
14.25=29.00 } By prob. 4. sect. 3.
8.37=17.48 }

15732
3496
A. R. P.
160)506.9200(3. 0. 27. content.

26 perch, or near 27.

Or, thus:

4 pole-chains.

Ch. L. Ch.L.

14.25=7.25 } By prob. 1. sect. 3.
8.37=4.37 }

5075
2175
2900

Acres 3|16825
4

Rood |67300
4

Perches 26|9200

To draw the map.

Make an oblong (by schol. to prob. 9. sect. 1.) whose length, from a scale of 20 to an inch, may be 29 perches, and breadth, 17.48 perches.

PROB. IV.

The content of an oblong piece of ground, and one side given, to find the other.

Divide the content in perches, by the given side in perches, the quotient is the required side in perches; and thence it may be easily reduced to chains.

EXAMPLE.

EXAMPLE.

Ch. L.
There is a ditch 14. 25 long, by the side of which it is required to lay out an oblong piece of ground, which shall contain 3A. 0R. 27P. what breadth must be laid off at each end of the ditch, to enclose the 3A. 0R. 27P.?

A. R. P.
3. 0. 27,
4

12
40
Perch. Ch. L.
29)507(17,48=8, 37 breadth,

217

140

240

8

The map is done as the last.

PROB. V.

To find the content of a piece of ground, in form of an oblique angular parallelogram; or of a rhombus, or rhomboides.

Multiply the base into the perpendicular height. The reason is plain from theo. 13. sect. 1.

EXAMPLE.

EXAMPLE.

Plate VII. fig. 2.

Let ABCD be a piece of ground in form of a rhombus, whose base AB is 22 chains, and perpendicular DE, or FC, 20 chains. Required the content.

Ch. Ch.
22=11.0 } 4 pole chains.
20=10.0 }
Acres 11|0

Or,

Ch.
22=44 } perches.
20=40 }
160)1760(11 acres.
160

The converse of this is done by prob. 4. and the map is drawn, by laying off the perpendicular on that part of the base from whence it was taken: joining the extremity thereof to that of the base, by a right line, and thence complete the parallelogram.

PROB.

PROB. VI.

To find the content of a triangular piece of ground.

Multiply the base by half the perpendicular, or the perpendicular by half the base; or take half the product of the base into the perpendicular.

The reason hereof is plain, from cor. 2. theo. 12. sect. 1.

EXAMPLE.

Plate I. fig. 16.

Let ABC be a triangular piece of ground, whose longest side or base BC, is 24C. 38L. and perpendicular AD, let fall from the opposite angle, is 13 C. 28L. Required the content.

$$\left.\begin{array}{rrr} & \text{Ch. L.} & \text{Ch. L.} \\ \text{1. Base} & 24.\ 38 = & 12.\ 38 \\ & \tfrac{1}{2}\ \text{perp.} & 3.\ 39 \end{array}\right\}\ \text{4 pole chains.}$$

11142
3714
3714

Acres 4|19682
4

Rood |78728
40

Perches 31|4912

A. R. P.
Content 4. 0. 31.

Perp.

Ch. L. Ch.L.
Perp. 13.28=6.78 } four-pole chains, by prob.
½ perp. 6.39=3.39 } 1. sect. 3.
Or 2dly. Perp. 6.78 of four-pole chains.
½ base 6.19

6102
678
4068

A. R. P.
4|19682 =4. 0. 31.

Or 3dly. Base 12.38 four-pole chains.
Perp. 6.78

9904
8666
7428

83.9364

A. R. P.
Its ½=4|19682=4. 0. 31.

Or the base and perpendicular may be reduced to perches; and the content may be thence obtained, thus;

Perp.

Ch. L. Perches.
Perp. 13.28=27.12
Half the perp. 13.56 } By prob. 4. sect. 3.

Perches. Ch. L.
1. Base 49.52=24.38
½ perp. 13.56

29712
24760
14856
4952

A. R. P.
160)671.4912(4. 0. 31.

31

Perches.
2. Perp. 27.12
Half base 24.76

16272
18984
10848
5424

A. R. P.
671.4912=4. 0. 31.

But, square perches may be reduced to acres, &c. rather more commodiously, by dividing by 40 and 4, than by 160; thus,

4|0)67|1.

4)16. 31

A. 4. 0. 31

3. Base.

Perch.
3. Base 49.52
Perp. 27.12

9904
4952
34664
9904

1342.9824

A. R. P.
671.4912 = 4. 0. 31.

The map may be readily drawn, having the distance from either end of the base, to the perpendicular given; as may be evident from the figure.

PROB. VII.

The content of a triangular piece of ground, and the base given, to find the perpendicular.

Divide the content in perches, by half the base in perches: and the quotient will give you the perpendicular in perches, and so in chains.

EXAMPLES.

Plate I. fig. 16.

Let BC be a ditch, whose length is 24C. 40L. by which it is required to lay out a triangular piece of ground, whose content shall be 4A. 1R. 10P. Required the perpendicular.

Ch. L. Perches.
Base 24.40 = 49.6
Half the Base =24.8
A. R. P.
4. 1. 10.
4

17
40
——Perches.
24.8)690(27.82

1940

2040

560

64

Perches. Ch. L.
Answer perp. 27.82=13.45.

This perpendicular being laid on any part of the base, and lines run from its extremity to the ends of the base, will lay out the triangle (by cor. to theo. 13. sect. 1.) so that the perpendicular may be set on that part of the base which is most convienient and agreeable to the parties concerned.

LEMMA.

LEMMA.

If from half the sum of the sides of any plane triangle ABC, each particular side be taken; and if the half sum, and the three remainders be multiplied continually into each other, the square root of this product will be the area of the triangle.

Plate VIII. fig. 9.

Bisect any two of the angles, as A and B, with the lines AB, BD meeting in D; draw the perpendiculars DE, DF, DG.

The triangle AFD is equiangular to AED; for the angle FAD=EAD by construction, and AFD = AED, being each a right angle, and of consequence ADF=ADE; wherefore AD : DF : : AD : DE : and since AD bears the same proportion to DF, that it doth to DE, DF=DE, and the triangle AFD=AED. The same way DE=DG; and the triangle DEB=DGB, and FD=DE =DG; therefore D will be the centre of a circle that will pass through E, F, G.

In the same way if A and C were bisected, the same point D would be had; therefore a line from D to C will bisect C, and thus the triangles DFC, DGC, will be also equal.

Produce CA to H, till AH = EB or GB; so will HC be equal to half the sum of the sides, *viz.* to $\frac{1}{2}$ AB, + $\frac{1}{2}$ AC + $\frac{1}{2}$ BC; for FC, FA, EB, are severally equal to CG, AE, BG; and all these together are equal to the sum of the sides of the triangle; therefore FC + FA + EB or CH, are equal to half the sum of the sides.

$FC=CH-AB$, for $AF=AE$, and $HA=EB$; therefore $HF=AB$; and $AF=CH-BC$; for $CF=CG$, and $AH=GB$; therefore $BC=HA+FC$, and $AH=CH-AC$.

Continue DC, till it meets a perpendicular drawn upon H, in K; and from K draw the perpendicular KI, and join AK.

Because the angles AHK and AIK are two right ones, the angle HIA and K together, are equal to two right; since the angles of the two triangles contain four right: in the same way $FDE+FAE=$ (2 right angles$=$) $FAE+IAH$; let FAE be taken from both, then $FDE=IAH$, and of course $FAE=K$; the quadrilateral figures AFDE, and KHAI, are therefore similar, and have the sides about the equal angles proportional; and it is plain the triangles CFD and [illegible]HK are also proportional; hence,

$$FD : HA :: FA : HK$$
$$FD : FC :: HK : HC$$

Wherefore by multiplying the extremes, and means in both, it will be the square of $FD \times HK \times HC = FC \times FA \times HA \times HK$; let HK be taken from both, and multiply each side by CH; then the square of CH × by the square of $FD = FC \times FA \times HA \times CH$.

It is plain, by the foregoing problem, that $\frac{1}{2} AB \times DE, + \frac{1}{2} BC \times DG + \frac{1}{2} AC \times FD =$ the area of the triangle; or that half the sum of the sides, *viz.* $CH + FD =$ the triangle; wherefore the square of CH × by the square of $FD = FC \times$

FA × HA × CH, that is, the half sum multiplied continually into the differences between the half sum and each side; will be the square of the area of the triangle, and its root the area. Q. E. D.

Hence the following problem will be evident.

PROB. VIII.

The three sides of a plane triangle given, to find the area.

RULE.

From half the sum of the three sides subtract each side severally; take the logarithms of the half sum and three remainders, and half their total will be the logarithm of the area: or, take the square root of the continued product of the half sum and three remainders for the area.

EXAMPLES.

Plate VIII. fig. 9.

1. *In the triangle ABC, are*

Given, $\left\{\begin{array}{l} AB=10.64 \\ AC=12.28 \\ BC=\ \ 9.00 \end{array}\right\}$ four-pole chains, required the area?

Sum	31.92		
Half sum	15.96	Log.	1.20303
Remainders	5.32	—	0.72591
	3.68	—	0.56585
	6.96	—	0.84261
			2)3.33740
Answer, Sqr. Ch.	46.63	log.	1.66870
or,	4.663	Acres.	

Or, $15.96 \times 5.32 \times 3.68 \times 6.96 = 2174.71113216$ the square root of which is 46.63, for the area as before.

2. What quantity of land is contained in a triangle, the 3 sides of which are, 80, 120 and 160 perches respectively? Answer 29A. 7P.

PROB. IX.

Two sides of a plane triangle and their included angle given, to find the area.

RULE.

To the log. sine of the given angle (or of its supplement to 180°, if obtuse) add the logarithms of the containing sides; the sum, less radius will be the logarithm of the double area.

EXAMPLES.

Plate V. fig. 16.

Suppose two sides, AB, AC, of a triangular lot ABC, form an angle of 30 degrees, and measure, one 64 perches, and the other 40.5, what must the content be?

Given angle	30°.	sine	9.69897
Containing sides	64.	log.	1.80618
	40.5	log.	1.60745
	2)1296.	log.	3.11260

160)648(4A. 8P. Answer.

8

2. Required the area of a triangle, two sides of which are 49.2 and 40.8 perches, and their contained angle $144\frac{1}{2}$ degrees? Answer, 3A. 2R. 22P.

3. What quantity of ground is inclosed in an equilateral triangle, each side of which is 100 perches, either angle being 60 degrees? Answer, 27A. 10P.

Demonstration of this problem.

Plate XI. fig. 3.

Let AH be perpendicular to AB and equal to AC and HE, FCG, parallel to AB then making AH (=AC) radius, AF (=CD) will be the sine of CAD, and the parallelograms ABEH (the product of the given sides) and ABGF (the double area of the triangle) having the same base AB, are in proportion as their heights AH, AF; that is, as radius to the sine of the given angle; which proportion gives the operation as in the rule above. Q. E. D.

PROB. X.

To find the area of a trapezoid, viz, a figure bounded by four right-lines, two of which are parallel, but unequal.

RULE.

Multiply the sum of the parallel sides by their perpendicular distance, and take half the product for the area.

EXAMPLES.

1. Required the area of a trapezoid, of which the parallel sides are respectively, 30 and 49 perches, and their perpendicular distance 61.6.

61.6

Note. On this 10th problem are founded most of the calculations of differences by latitude and departure, and those by offsets, following in this treatise.

$$\left.\begin{array}{r}61.6\\ 30+49=79.\end{array}\right\}\text{ Multiply.}$$

$$\begin{array}{r}\hline 2)4866.4\\ \hline\end{array}$$

Answer, 2433.2=15A. 33.2P.

Plate VIII. fig. 10.

2. In the trapezoid ABCD the parallel sides are, AD, 20 perches, BC, 32, and their perpendicular distance, AB, 26; required the content?

Answer, 4A. 36P.

PROB. XI.

To find the Content of a trapezium.

RULE.

Multiply the diagonal, or line joining the remotest opposite angles, by the sum of the two perpendiculars falling from the other angles to that diagonal and half the product will be the area.

EXAMPLE.

Plate VII. fig. 3.

Let ABCD be a field in form of a trapezium, the diagonal AC 64.4 perches, the perpendicular B*b* 13.6 and D*d*. 27.2, required the content?

$$\left.\begin{array}{r}\text{Diagonal} = 64.4\\ 13.6+27.2=40.8\end{array}\right\}\text{ Multiply.}$$

$$\begin{array}{r}\hline 2)2627.52\\ \hline\end{array}$$

$$\begin{array}{l}160)1313.76(8\text{A. } 33\tfrac{1}{4}\text{P. Answer.}\\ \quad\;\;\, 1280\\ \hline \quad\;\;\, 33\tfrac{1}{4}\end{array}$$

Note. The method of multiplying together the half sums of the opposite sides of a trapezium for the content is erroneous, and the more so the more oblique its angles are.

To draw the map; set off *Ab* 28 perches and *Ad* 34.4, and there make the perpendiculars to their proper lengths, and join their extremities to those of the diagonal.

P R O B. XII.

To find the area of a circle, or an ellipsis.

RULE.

Multiply the square of the circle's diameter, or the product of the longest and shortest diameters of the ellipsis by .7854 for the area. Or, subtract 0.10491 from the double logarithm of the circle's diameter, or from the sum of the logarithms of those elliptic diameters, and the remainder will be the logarithm of the area.

Note. In any circle, the

$$\left.\begin{array}{l}\text{Diam. multi.}\\ \text{Circum. div.}\end{array}\right\}\text{ by } 3.14159, \left\{\begin{array}{l}\text{produces the Cir.}\\ \text{quotes the diam.}\end{array}\right.$$

EXAMPLES.

1. How many acres are in a circle of a mile diameter?

1 Mile=320. per. log. 2.50515
2.50515
5.01030
0.10491
4,0)8042|5. log. 4.90539
4)2010.25

Answer, 502A. 2R. 25P.

2. A gentleman, knowing that the area of a circle is greater than that of any other figure of equal perimeter, walls in a circular deer-park of 100 perches diameter, in which he makes an elliptical fish-pond 10 perches long by 5 wide; required the length of his wall, content of his park, and area of his pond?

Answer, the wall 314.16 perches, inclosing 49A. 14P. of which $39\frac{1}{4}$ perches, or $\frac{1}{4}$ of an acre nearly is appropriated to the pond.

PROB. XIII.

The area of a circle given to find its diameter.

RULE.

To the logarithm of the area add 0.10491, and half the sum will be the logarithm of the diameter. Or divide the area by .7854 and the square root of the quotient will be the diameter.

EXAMPLE.

A horse in the midst of a meadow suppose,
Made fast to a stake by a line from his nose,
How long must this line be, that feeding all round,
Permits him to graze just an acre of ground?

Area in perches 160 log. 2.20412
0.10491

2)2.30903

2)
Diameter 14.2733 log. 1.15451

Answer, 7.13665 per.=117F. 9In.

PROB.

PROB. XIV.

To make the proper allowance for roads.

It is customary to deduct 6 acres out of 106 for roads; the land before the deduction is made may be termed the *gross*, and that remaining after such deduction, the *neat*.

RULE.

$$\left.\begin{array}{l}\text{The gross div.}\\ \text{The neat mul.}\end{array}\right\}\text{ by } 1.06, \left\{\begin{array}{l}\text{quotes the neat.}\\ \text{prod. the gross.}\end{array}\right.$$

EXAMPLES.

1. How much land must I enclose to have 850A. 2R. 20. neat.

40|20.
4| 2.5

Acres. A. R. P.
850.625 × 1.06=901.6625=901. 2. 26. the ans.

2. How much neat land is there in a tract of 901A. 2R. 26P. gross?

40|26.
4| 2.65

Acres. A. R. P.
1.06)901.6625(850·625=850. 2. 20. the answ.
848

&c.

Note. These two operations prove each other.

PROB.

PROB. XV.

To find the area of a piece of ground, be it ever so irregular, by dividing it into triangles and trapezia.

Plate VII. fig. 4.

We here admit the survey to be taken, and protracted; by having therefore the map, and knowing the scale by which it was laid down, the content may be thus obtained.

Dispose the given map into triangles, by fine pencilled lines, such as are here repsesented by popp'd lines in the scheme, and number the triangles with 1, 2, 3, 4, *&c.* Your map being thus prepared, rule a table with four columns; the first of which is for the number of the triangle, the second for the base of it, the third for the perpendicular, and the fourth for the content in perches.

Then proceed to measure the baſe of number 1, from the scale of perches the map was laid down, and place that in the second column of the table, under the word base; and from the angle opposite to the base, open your compasses so, as when one foot is in the angular point, the other being moved backwards, and forwards may just touch the base line, and neither go the least above or beneath it; that distance in the compasses, measured from the same scale, is the length of that perpendicular, which place in the third column, under the word perpendicular.

If the perpendiculars of two triangles fall on one and the same base, it is unnecessary to put down the base twice, but insert the second perpendicular opposite to the number of the triangles in the table, and join it with the other perpendicular by a brace, as No. 1 & 2, 4 & 5, 6 & 7, 9 & 10, *&c.*

Proceed after this manner, till you have measured all the triangles; and then by prob. 6 find the content in perches of each reſpective triangle which severally place in the table opposite to the number of the triangle, in the fourth column, under the word content.

But where two perpendiculars are joined together in the table, by a brace, having both one and the same base; find the content of each (being a trapezium) in perches, by prob. 11. which place opposite the middle of those perpendiculars, in the fourth column, under the word content.

Having thus obtained the content of each respective triangle and trapezium, which the map contains, add them all together, and their sum will be the content of the map in perches; which being divided by 160, gives the content in acres. Thus, for

EXAMPLE.

EXAMPLE.

No.	Base.	Perpend.	Content.
1	24.8	17.0	412.92
2		16.3	
3	28.2	16.0	225.6
4	39.8	19.6	712.42
5		16.2	
6	49.4	29.0	1086.8
7		15.0	
8	38.7	6.7	129.64
9	40.0	17.0	600.
10		13.0	
11	42.8	10.2	481.5
12		12.3	
13	26.2	17.9	234.49
14	24.0	11.6	259.2
15		10.0	
Content in perches			4142.57

This being divided by 160, will give 25A. 3R. 22P. the content of the map.

Let your map be laid down by the largest scale your paper will admit, for then the bases and perpendiculars can be measured with greater accuracy than when laid down by a smaller scale; and if possible measure from scales divided diagonally.

If the bases and perpendiculars were measured by four-pole chains, the content of every triangle and trapezium, may be had as before, in problems 6. and 11. and consequently the whole content of the map.

If any part of your map has short or crooked bounds, as those represented in plate VII. fig. 5. then by the straight edge of a transparent horn, draw a fine pencilled line as AB, to balance the parts taken in and left out, as also another, BC; these parts when small, may be balanced very nearly by the eye, or they may be more accurately balanced by method the third. Join the points A and C by a line, so will the content of the triangle ABC, be equal to that contained between the line AC, and the crooked boundary from A to B, and to C: by this method the number of triangles will be greatly lessened, and the content become more certain; for the fewer operations you have, the less subject will you be to err: and if an error be committed, the sooner it may be discovered.

The lines of the map should be drawn small, and neat, as well as the bases; the compasses neatly pointed, and scale accurately divided; without all which you may err greatly. The multiplications should be run over twice at least, as also the addition of the column content.

From what has been said, it will be easy to survey a field, by reducing it into triangles, and measuring the bases and perpendiculars by the chain. To ascertain the content only, it is not material to know at what part of the base the perpendicular was taken: since it has been shewn (in cor. to theo. 13. sect. 1.) that triangles on the same base, and between the same parallels are equal: but if you would draw a map from the bases and perpendiculars, it is evident that you must know at what part of the base the perpendicular was taken; in order to set it off in its due position; and hence the map is easily constructed.

PROB. XVI.

To determine the area of a piece of ground, having the map given, by reducing it to one triangle equal thereto, and thence finding its content.

Plate VIII. fig. 5.

Let A B C D E F G H be a map of ground, which you would reduce to one triangle equal thereto.

Produce any line of the map as AH, both ways; lay the edge of a parallel ruler from A to C, having B above it; hold the other side of the ruler, or that next you, fast; open till the same edge touches B, and by it, with a protracting pin, mark the point *b* on the produced line; lay the edge of the ruler from *b* to D, having C above it; hold the other side fast, open till the same edge touches C, and by it mark the point *c*, on the produced line. A line drawn from *c* to D will take in as much as it leaves out of the map.

Again, lay the edge of the ruler from H to F, having G above it, keep the other side fast, open till the same edge touches G, and by it mark the point *g*, on the produced line; lay the edge of the ruler from *g* to E, having F above it, keep the other side fast, open till the same edge touches F, and by it mark the point *f*, on the produced line. Lay the edge of the ruler from *f* to D, having E above it, keep the other side fast, open till the same edge touches E, and by it mark the point *e*, on the produced line. A line drawn from D to *e*, will take in as much as it leaves out. Thus have you the triangle *c* D *e*, equal to the irregular polygon A B C D E F G H.

If when the ruler's edge be applied to the points A and C, the point B falls under the ruler, hold that side next the said points fast, and draw back the other to any convenient distance; then hold this last side fast, and draw back the former edge to B, and by it mark *b*, on the produced line: and thus a parallel may be drawn to any point under the ruler, as well as if it were above it. It is best to keep the point of your protracting pin in the last point in the extended line, till you lay the edge of the ruler from it to the next station, or you may mistake one point for another.

This may also be performed with a scale, or ruler, which has a thin sloped edge, called a fiducial, or sure edge; and a fine pointed pair of compasses. Thus,

Lay that edge on the points A and C, take the distance from the point B to the edge of the scale, so that it may only touch it, in the same manner as you take the perpendicular of a triangle; carry that distance down by the edge of the scale parallel to it, to *b*; and there describe an arc on the point *b*, and if it just touches the ruler's edge, the point *b* is in the true place of the extended line. Lay then the fiducial edge of the scale from *b* to D, and take a distance from C, that will just touch the edge of the scale; carry that distance along the edge, till the point which was in C, cuts the produced line in *c*; keep that foot in *c*, and describe an arc, and if it just touches the ruler's edge, the point *c* is in the true place of the extended line. Draw a line from *c* to D, and it will take in and leave out equally; in like manner the other side of the figure may be balanced by the line *e* D.

Let the point of your compasses be kept to the last point of the extended line, till you lay your scale from it to the next station, to prevent mistakes from the number of points.

That the triangle *c* D *e*, is equal to the right-lined figure A B C D E F G H, will be evident from problems 18. 19. sect. 1. for thereby if a line were drawn from *b* to C, it will give and take equally, and then the figure *b* CDEFGH, will be equal to the map. Thus the figure is lessened by one side, and by the next balance line will lessen it by two, and, so on, and will give and take equally. In the same manner an equality will arise on the other side.

The area of the triangle is easily obtained, as before, and thus you have the area of the map.

It is best to extend one of the shortest lines of the polygon, because if a very long line be produced, the triangle will have one angle very obtuse, and consequently the other two very acute: in which case it will not be easy to determine exactly the length of the longest side, or the points where the balancing lines cut the extended one.

This method will be found very useful and ready in small enclosures, as well as very exact; it may be also used in large ones, but great care must be taken of the points on the extended line, which will be crowded, as well as of not missing a station.

PROB. XVII.

A map with its area being given, and its scale omitted to be either drawn or mentioned; to find the scale.

CAST up the map by any scale whatsoever, and it will be,

As the area found
Is to the square of the scale by which you cast up,
: : The given area of the map
To the square of the scale by which it was laid down.

The square root of which will give the scale.

EXAMPLE.

A map whose area is 126A. 3R. 16P. being given; and its scale omitted to be either drawn or mentioned; to find the scale.

Suppose this map was cast up by a scale of 20 perches to an inch, and the content thereby produced be 31A. 2R. 34P.

As the area found, 31A. 2R. 34P.=5074P.
Is to the square of the scale by which it was cast up, that is, to 20×20=400,
: : The given area of the map 126A. 3R. 16P. =20296P.
To the square of the scale by which it was laid down,

5074 : 400 : : 20296 : 1600 the square of the required scale.

```
   Root.
1600(40
16
----
8(00
----
```

Answer. The map was laid down by a scale of 40 perches to an inch.

PROB. XVIII.

How to find the true content of a survey, though it be taken by a chain that is too long or too short.

Let the map be constructed, and its area found as if the chain were of the true length. And it will be

As the square of the true chain
Is the content of the map,
: : The square of the chain you surveyed by
To the true content of the map.

EXAMPLE.

EXAMPLE.

If a survey be taken with a chain which is 3 inches too long; or with one whose length is 42 feet 3 inches, and the map thereof be found to contain 920A. 2R. 20P. Required the true content.

As the square of 42F. 0In.=the square of 504 inches=254016
Is to the content of the map 920A. 1R. 20P. =147260P.
: : The square of 42F. 3In.=the square of 507 inches=257049
To the true content.

P. P.
254016 : 147260 : : 257049 : 149019

A. R. P.
160)149019(931 . 1 . 19 answer.
501
219
40)59(1R.
19P.

SECT. V.

Third Method for determining the Areas of right-lined Figures universally, or by Calculation.

CALCULATION.

DEFINITIONS.

Plate VIII. fig. 7.

1. MERIDIANS are north and south lines, which are supposed to pass through every station of the survey.

2. The difference of latitude, or the northing or southing of any stationary line, is the distance that one end of the line is north or south from the other end; or it is the distance which is intercepted on the meridian, between the beginning of the stationary line and a perpendicular drawn from the other end to that meridian. Thus, if N. S. be a meridian line passing through the point A of the line AB, then is *Ab* the difference of latitude, or southing of that line.

3. The departure of any stationary line, is the nearest distance from one end of the line to a meridian passing through the other end. Thus B*b* is the departure or easting of the line AB: but if CB be a meridian, and the measure of the stationary distance be taken from B to A; then is BC the difference of latitude, or northing, and AC the departure or westing of the line BA.

4. That meridian which passes through the first station, is sometimes called the first meridian; and sometimes it is a meridian passing on the east or west side of the map, at the distance of the breadth thereof, from east to west, set off from the first station.

5. The meridian distance of any station is the distance thereof from the first meridian, whether it be supposed to pass through the first station, or on the east or west side of the map.

THEO. I.

In every survey which is truly taken, the sum of the northings will be equal to that of the southings; and the sum of the eastings equal to that of the westings.

Plate IX. fig. 1.

Let *a*, *b*, *c*, *e*, *f*, *g*, *h*, represent a plot, or parcel of land. Let *a* be the first station, b the second, *c* the third, &c. Let NS be a meridian line, then will all lines parallel thereto, which pass through the several stations, be meridians also; as *ao*, *bs*, *cd*,

cd, &c. and the lines bo, cs, de, &c. perpendicular to those, will be east or west lines, or departures.

The northings $ei+go+bq=ao+bs+cd+fr$ the southings: for let the figure be completed; then it is plain, that $go+bq+rk=ao+bs+cd$, and $ei-rk=fr$. If to the former part of this first equation $ei-rk$ be added and fr to the latter, then $go+bq+ei=ao+bs+cd+fr$; that is, the sum of the northings is equal to that of the southings.

The eastings $cs+qa=ob+de+if+rg+ab$, the westings. For $aq+yo$ $(az)=de+if+rg+ob$, and $bo=cs-yo$. If to the former part of this first equation, $cs-yo$ be added, and bo to the latter, then $cs+aq=ob+de+if+rg+ob$; that is, the sum of the eastings is equal to that of the westings. Q. E. D.

SCHOLIUM.

This theorem is of use to prove whether the field-work be truly taken, or not; for if the sum of the northings be equal to that of the southings, and the sum of the eastings to that of the westings, the field-work is right, otherwise not.

Since the proof and certainty of a survey depend on this truth, it will be necessary to shew how the difference of latitude and departure for any stationary line, whose course and distance are given, may be obtained by the tables hereunto annexed.

To

To find the Difference of Latitude and Departure, by the Help of the annexed Table.

This table is so contrived, that by finding therein the given course, and a distance not exceeding 100 miles, chains, perches, or feet, the difference of latitude and departure is had by inspection; the course is to be found at the top of the table when under 45 degrees; but at the bottom of the table when above 45 degrees. Each column signed with a course consists of two parts, one for the difference of latitude, marked Lat. the other for the departure, marked Dep. which names are both at the top and bottom of these columns. The distance is to be found in the column marked Dist. next the margin of the page.

EXAMPLE.

In the use of those tables, a few observations only are necessary.

1. If a station consist of any number of even chains or perches (which are almost the only measures used in surveying) the latitude and departure are found at sight under the bearing or course, if less than 45 degrees; or over it if more, and in a line with the distance.

2. If a station consist of any number of chains and perches, and decimals of a chain or perch, under the distance 10, the lat. and dep. will be found as above, either over or under the bearing;

the decimal point or separatrix being removed one figure to the left, which leaves a figure to the right to spare.

3. If the distance be any number of chains, or perches, and the decimals of a chain or perch, the lat. and dep. must be taken out at two or more operations, by taking out the lat. and dep. for the chains, or perches in the first place, and then for the decimal parts.

To save the repeated trouble of additions, a judicious surveyor will always limit his stations to whole chains, or perches and lengths, which can commonly be done at every station, save the last.

1. In order to illustrate the foregoing observations, let us suppose a course or bearing, to be S. 35°. 15′ E. and the distance 79 four-pole chains. Under 35°. 15′ or $35\frac{1}{4}$ degrees, and opposite 79, we find 64. 52 for the latitude, and 45. 59 the departure, which signify that the end of that station differs in latitude from the beginning 64. 52 chains, and in departure 44. 59 chains.

Note, We are to understand the same things if the distance is given in perches or any other measures, the method of proceeding being exactly the same in every case.

Again let the bearing be $54\frac{3}{4}$ degrees, and distance as before; then over said degrees we find the same numbers, only with this difference, that the lat. before found, will now be the dep. and the dep. the lat. because $54\frac{3}{4}$ is the complement of $35\frac{1}{4}$ degrees to 90, *viz.* lat. 45. 59. dep. 64. 52.

2. Suppose the same course, but the distance 7 chains 90 links, or as many perches. Here we find the same numbers, but the decimal point must be removed one figure to the left.

Thus, under $35\frac{1}{4}$, and in a line with 79 or 7.9, are

Lat. 6. 45
Dep. 4. 56

the 5 in the dep. being increased by 1, because the 9 is rejected; but over $54\frac{3}{4}$ we get

Lat. 4. 56
Dep. 6. 45

3. Let the course be as before, but the distance 7.79, then opposite

7. 70	Lat. 6. 29	Dep. 4. 43
9	7	6
7. 79	6. 36	4. 49

Or opposite

7. 00	Lat. 5. 72	Dep. 4. 03
. 79	. 64	. 46
7. 79	6. 36	4. 49

THEO. II.

When the first meridian passes through the map.

If the east meridian distances in the middle of each line be multiplied into the particular southing, and the west meridian distances into the particular northing, the sum of these products will be the area of the map.

Plate X. fig. 1.

Let the figure *abkm* be a map, the lines, *ab*, *bk*, to the southward, and *km*, *ma*, to the northward, NS the first meridian line passing through the first station *a*.

$$\left.\begin{array}{l}\text{The meridian}\\ \text{Distances east}\end{array}\right\}\left.\begin{array}{l} zd\times ao\\ tu\times ox\,(by)\end{array}\right\} = \text{Area}\left\{\begin{array}{l} am\\ aw\end{array}\right.$$

$$\left.\begin{array}{l}\text{The meridian}\\ \text{Distances west}\end{array}\right\}\left.\begin{array}{l} ef\times gx\\ hh\times ga\,(my)\end{array}\right\} = \text{Area}\left\{\begin{array}{l} xp\\ gl\end{array}\right.$$

These four areas $am + aw + xp + gl$ will be the area of the whole figure *cmswiprlc*, which is equal to the area of the map *abkm*. Complete the figure.

The parallelograms *am* and *ow*, are made of the east meridian distances *dz* and *tu*, multiplied into the southings *ao* and *ox*. The parallelograms *xp* and *gl* are composed of the west meridian distances

tances *ef* and *hh*, multiplied into the northings *xg* and *ga* (*my*) but these four parallelograms are equal to the area of the map; for it from them be taken the four triangles marked Z, and in the place of those be substituted the four triangles marked O, which are equal to the former; then it is plain the area of the map will be equal to the four parallelograms. Q. E. D.

THEO. III.

If the meridian distance when east, be multiplied into the southings, and the meridian distance when west be multiplied into the northings, the sum of these less by the meridian distance when west, multiplied into the southings, is the area of the survey.

Plate X. fig. 2.

Let *a b c* be the map.

The figure being completed, the rectangle *af*, is made of the meridian distance *eq* when east, multiplied into the southing *an*; the rectangle *yk* is made of the meridian distance *xw*, multiplied into the northing *cz* or *ya*. These two rectangles, or parallelograms, *af* + *yk*, make the area of the figure *dfnyikd*, from which taking the rectangle *oy*, made of the meridian distance *tu* when west, into the southing *ob* or *bm*, the remainder is the area of the figure *dfobikd*, which is equal to the area of the map.

Let *bou*=Y, *urib*=L, *ric*=O, *wrc*=Z, *akw* =K, and *efb*=B, *ade*=A. I say, that Y+Z+B =K+L+A.

Y=L+O, add Z to both, then Y+Z=L+O+Z; but Z+O=K, put K instead of Z+O, then Y+Z=L+K, add to both sides the equal triangles B and A, then Y+Z+B=L+K+A. If therefore B+Y+Z be taken from *abc*, and in lieu thereof we put L+K+A, we shall have the figure *dfobikd*=*abc*, but that figure is made up of the meridian distance when east, multiplied into the southing, and the meridian distance, when west, multiplied into the northing less by the meridian distance, when west, multiplied into the southing. Q. E. D.

COROLLARY.

Since the meridian distance (when west) multiplied into the southing, is to be subtracted, by the same reasoning the meridian distance when east, multiplied into the northing, must be also subtracted.

SCHOLIUM.

From the two preceding theorems we learn how to find the area of a map, when the first meridian passes through it; that is, when one part of the map lies on the east and the other on the west side of that meridian. Thus,

RULE.

RULE.

The merid. { east } multiplied { southings }
Dist. when { west } into the { northings }
their sum is the area of the map.

But,

The merid. { east } multiplied { northings }
Dist. when { west } into the { southings }
the sum of these products taken from the former, gives the area of the map.

These theorems are true, when the surveyor keeps the land he surveys, on his right hand, which we suppose thro' the whole to be done; but if he goes the contrary way, call the southings northings, and the northings southings, and the same rule will hold good.

General Rule for finding Meridian Distances.

1. The meridain distance and departure, both east, or both west, their sum is the meridian distance of the same name.

2. The meridain distance and departure of different names; that is, one east and the other west, their difference is the meridian distance of the same name with the greater.

Thus in the first method of finding the area, as in the following field-book.

The first departure is put opposite to the northing or southing of the first station, and is the first meridian distance of the same name. Thus if the first departure be east, the first meridian distance will be the same as the departure, and east also; and if west, it will be the same way.

The first meridian distance	6.61	E.
The next departure	6.61	E.
The second meridian distance	13.22	E.
The next departure	1.80	E.
The third meridian distance	15.02	E.

At station 5, the meridian distance	5.78	E.
The next departure	7.76	W.
The next meridian distance	1.98	W.

At station 11, the meridian distance	0.12	W.
The next departure	5.84	E.
The next meridian distance	5.72	E.

Plate X. fig. 3.

In the 5th and 11th stations, the meridian distances being less than the departures, and of a contrary name, the map will cross the first meridian, and will pass as in the 5th line, from the east to the west side of the meridian; and in the 11th line it will again cross from the east to the west side, which will evidently appear, if the field-work be protracted, and the meridian line passing through the first station, be drawn through the map.

The field-book cast up by the first method will be evident from the two foregoing theorems, and therefore requires no further explanation; but *to find the area by the second method*, take this

RULE.

When the meridian distances are east, put the products of north and south areas in their proper columns; but when west, in their contrary columns; that is, in the column of south area, when the difference of latitude is north; and in north when south: the reason of which is plain, from the two last theorems. The difference of these two columns will be the area of the map.

No St.	Bearings.	C. L.	Lati. and halfDep.	Merid. Dist.	Area.	Deduct.
1	NE 75	13.70	N 3.54 E 6.61	6.61 E 13.22 E		23.3994
2	NE 20½	10.30	N 9.65 E 1.80	15.02 E 16.82 E		144.9430
3	East	16.20	0.00 E 8.10	24.92 E 33.02 E		
4	SW 33½	35.30	S 29.44 W 9.74	23.28 E 13.54 E	685.3632	
5	SW 76	16.00	S 3.87 W 7.76	5.78 E 1.98 W	22.3686	
6	North	9.00	N 9 00 0.00	1.98 W 1.98 W	17.8200	
7	SW 84	11.60	S 1.21 W 5.77	7.75 W 13.52 W		9.3775
8	NW 53¼	11.60	N 6.94 W 4.64	18 16 W 22.80 W	126.0304	
9	NE 36¾	19.20	N 15.38 E 5.74	17.06 W 11.32 W	262.3828	
10	NE 22½	14.00	N 12.93 E 2.68	8.64 W 5.96 W	111.7152	
11	SE 76¾	12.00	S 2.75 E 5.84	0.12 W 5.72 E		0.3300
12	SW 15	10.85	S 10.48 W 1.40	4.32 E 2.92 E	45.2736	
13	SW 16¾	10.12	S 9.69 W 1.46	1.46 E 0.00	14.1474	
					1285.1012 178.0499	178.0499
				Content in chains,	1107.0513	

The

It is needless here to insert the columns of bearing or distances in chains, being the same as before.

No St.	Lati. and half Dep.	Merid. Dist.	N. Area.	S. Area.
1	N 3.54 E 6.61	6.61 E 13.22 E	23.3994	
2	N 9.65 E 1.80	15.02 E 16.82 E	144.9430	
3	0.00 E 8.10	24.92 E 33.02 E		
4	S 29.44 W 9.74	23.28 E 13.54 E		685.3632
5	S 3.87 W 7.76	5.78 E 1.98 W		22.3686
6	N 9.00 0.00	1.98 W 1.98 W		17.8200
7	S 1.21 W 5.77	7.75 W 13.52 W	9.3775	
8	N 6.94 W 4.64	18.16 W 22.80 W		126.0304
9	N 15.38 E 5.74	17.06 W 11.32 W		262.3828
10	N 12.93 E 2.68	8.64 W 5.96 W		111.7152
11	S 2.75 E 5.84	0.12 W 5.72 E	0.3300	
12	S 10.48 W 1.40	4.32 E 2.92 E		45.2736
13	S 9.69 W 1.46	1.46 E 0,00		14.1474
			178.0499	1285.1012
				178.0499
		Area in chains, as before,		1107.0513

The Construction of the Map from either the 1st or 2d Table.

Plate X. fig. 3.

Draw the line NS. for a north and south line, which call the first meridian; in this line assume any point, as 1, for the first station. Set the northing of that stationary line, which is 3.54, from 1 to 2, on the said meridian line. Upon the point 2 raise a perpendicular to the east-ward, the meridian distance being easterly, and upon it set 13.22, the second number in the column of meridian distance, from 2 to 2, and draw the line 1 2, for the first distance line: from 2 upon the first meridian, set the northing of the second stationary line, that is, 9.65 to 3, and on the point 3 erect a perpendicular eastward, upon which set the meridian distance of the second station 16.82, from 3 to 3, and draw the line 2 3, for the distance line of the second station. And since the third station has neither northing nor southing, set the meridian distance of it 33.02 from 3 to 4, for the distance line of the third station. To the fourth station there is 29.44, southing, which set from 3 to 5; upon the point 5 erect the perpendicular 5 5, on which lay 13.54, and draw the line 4 5.

In like manner proceed to set the northings and southings on the first meridian, and the meridian distances upon the perpendiculars raised to the east or west; the extremities of which connected by right lines, will complete the map.

A

SPECIMEN

OF THE

Pennsylvania Method of Calculation.

Which, for its Simplicity and Ease, in finding the Meridian distances, is supposed to be preferable in Practice to any thing heretofore published on the Subject.

FIND in the first place, by the following tables, the lat. and dep. for the several courses and distances, as already taught; and if the survey be truly taken, the sums of the northings and southings will be equal, and also those of the eastings and westings. Then in the next place, find the meridian distances, by choosing such a place in the column of eastings or westings, as will admit of a continual addition of the one, and subtraction of the other; by which means we avoid the inconvenience of changing the denomination of either of the departures.

The learner must not expect that in real practice the columns of lat. and those of dep. will exactly balance when they are at first added up, for little inaccuracies will arise, both from the observations taken in the field, and in chaining; which to adjust, previous to finding the meridian distances, we may observe, That if, in small surveys, the difference amount to two tenths of a perch for every station, there must have been some error committed in the field; and the best way in this case, will be to rectify it on the ground by a re-survey, or at least as much as will discover the error. But when the differences are within these limits, the work may be balanced in the following manner: on a slate or separate piece of paper, find the lat. and dep. to each course and distance, as in the following example, observing to add an half of the differences to the numbers in the lesser column, and to subtract it from those of the greater, in such manner, as that the numbers may be altered nearly in proportion to their corresponding distances.

EXAMPLE.

Field-Notes.			From the Tables.				Balanced.			
No.	Courses.	Per.	N.	S.	E.	W.	N.	S.	E.	W.
1	S. 40 W.	70		53.6		45.0		53.6		45.0
2	N. 45 W.	89	62.9			62.9	63.0			62.9
3	N. 36. E.	125	101.1		73.5		101.2		73.5	
4	North.	54	54.0				54.0			
5	S. 81 E.	186		29.1	183.7			29.0	183.6	
6	S. 8 W.	137		135.7		19.1		135.6		19.2
7	West.	130				130.0				130.0
	A. R. P.		218.0	218.4	257.2	257.0	218.2	218.2	257.1	257.1
	207. 3. 22.69			218.0	257.0					
			Diff.	.4	.2					
			½ Diff.	.2	.1					

The latitudes and departures being thus balanced, proceed to insert the meridian distances by the above method, where we still make use of the same field-notes, only changing chains and links into perches and tenths of a perch. Then by looking along the column of departure. it is easy to observe, that in the columns of easting, opposite station 9, all the eastings may be added, and the westings subtracted without altering the denomination of either. Therefore, by placing 46.0 the east departure belonging to this station in the column of meridian distances, and proceeding to add the eastings and subtract the westings, according to the rule already mentioned, we shall find that at station 8, these distances will end in 0, 0, or a cypher, if the additions and subtractions be rightly made. Then multiplying the upper meridian distance of each station by its respective northing or southing, the product will give the north or south area, as in the examples already insisted on, and which is fully exemplified in the annexed specimen. When these products are all made out, and placed in their respective columns, their difference will give double the area of the plot, or twice the number of acres contained in the survey. Divide this remainder by 2, and the quotient thence arising by 160 (the number of perches in an acre) then will this last quotient exhibit the number of acres and perches contained in the whole survey; which in this example, may be called 110 acres, 103 perches, or 110 acres, 2 quarters, 23 perches.

FIELD-NOTES *of the two foregoing Methods, as practiſed in Pennſylvania.*

Caſt up by perches and tenths of a perch.

N.	Courſes.	Diſt.	N.	S.	E.	W.	M.D.	N. Area.	S. Area.
1	N 75.00 E	54.8	14.2		52.9		235.3 288.2	3341.26	
2	N 20.30 E	41.2	38.6		14.4		302.6 317.0	11680.36	
3	Eaſt.	64.8			64.8		381.8 446.6		
4	S 33.30 W	141 2		117.7		77.9	368.7 290.8		43395.99
5	S 76.00 W	64.0		15.5		62.1	228.7 166.6		3544.85
6	North.	36.0	36.0				166.6 166.6	5997.60	
7	S 84.00 W	46.4		4 9		46.1	120.5 74.4		590.45
8	N 53.15 W	46.4	27.8		46.0	37.2	37.2 00.0	1034.16	
9	N 36.45 E	76.8	61.5		21.4		46.0 92.0	2829.00	
10	N 22.30 E	56.0	51.7		46.7		113.4 134.8	5862.78	
11	S 76.45 E	48.0		11.0			181.5 228.2		1996.50
12	S 15.00 W	43.4		41.6		11.2	217.0 205.8		9092.30
13	S 16.45 W	40.5		38.8		11.7	194.1 182.4		7531.08
			229:8	229.8	246.2	246.2		30745.16	66151.17 30745,16
								2	35406.01
								Area in perches	17703.005

SECT. VI.

Containing the Nature of Off-sets and Intersections; the Methods of enlarging, or diminishing, and connecting Maps; the Variation of the Compass, and its Uses in Surveying; the whole concluding with some necessary Directions concerning Surveys in general.

OF

OFF-SETS.

IN taking surveys it is unnecessary and unusal to make a station at every angular point, because the field-work can be taken with much greater expedition, by using off-sets and intersections, and with equal certainty; especially where creeks, &c. bound the survey.

Off-sets are perpendicular lines drawn or measured from the angular points of the land, that lie on the right or left hand to the stationary distance, thus,

Plate XI. fig. 2.

Let the black lines represent the boundaries of a farm or township: and let 1 be the first station,

tion, then if you have a good view to 2, omit the angular points between 1 and 2, and take the bearing and length of the stationary line 1, 2, and insert them in your field-book: but in chaining from 1 to 2, stop at *d* opposite to the angular point *a*, and in your field-book insert the distance from 1 to *d*, which admit to be 4C. 25L. as well as the measure of the off-set *ad*, which admit to be 1C. 12L. thus: by the side of your field-book in a line with the first station, say at 4C. 25L. L. 1C. 12L. that is, at 4C. 25L. there is an off-set to the left hand of 1C. 12L.

This done proceed on your distance line to *e*, opposite to the angle *b*, and measure *eb*, supposing then 1 *e* to be 7C. 40L. and *eb* 3C. 40L. say (still in a line with the first station in your field-book) "at 7C. 40L. L. 3C. 40L." that is, at 7C. 40L. there is an off-set to the left of 3C. 40L. proceed then with your distance line to *f*, opposite to the angle *c*, and measure *fc*; suppose then 1 *f* to be 13C. and *fc* 1C. 25L. say in the same line as before, at 13C. L. 1C. 25L. Then proceed from *f* to 2, and you will have the measure of the entire stationary line 1, 2, which insert in its proper column by the bearing.

In taking off-sets, it is necessary to have a perch-chain, or a staff of half a perch, divided into links for measuring them; for by these means the chain in the stationary line is undisturbed, and the number of chains and links in that line from whence, or to which, the off-sets are taken, may be readily known.

Having arrived at the second station, if you find your view will carry you to 3, take the bearing from 2 to 3, and in measuring the distance line, stop at *l* opposite *g*; admit 2*l* to be 4C. 10L. and the off-set *lg* 1C. 20L. then in a line with the second station in your field-book, say at 4C. 10L. R. 1C. 20L. that is the off-set is a right-hand one of 1C. 20L. Again at *m*, which suppose to be 10C. 25L. from 2; take the off-set *mh* of 1C. 15L. and in a line with the second station, say at 10C. 25L. R. 1C. 15L. In the same line when you come to the boundary at *i*, insert the distance 2*i*, 13C. 10L. thus, at 13C. 10L. 0; that is, at 13C. 10L. there is no off-set. At *n*, which is 15C. from 2, take the off-set *nk* 45L. and still opposite to the second station say at 15C. L. 45L.

Let the line 3, 6, represent the boundary, which by means of water, briers, or any other impediment cannot be measured. In this case make one or more stations within or without the land, where the distances may be measured, and draw a line from the beginning of the first to the end of the last distance, thus; make stations at 3, 4, and 5, taking the bearings, and measuring the distances as usual, which insert in your field-book, and draw a mark like one side of a parenthesis, from the third to the fifth station, to shew that a line drawn from the third station to the furthest end of the fifth stationary line will express the boundary, Thus,

No. Sta.	Deg.	Ch. L.
3	$172\frac{1}{2}$	5.45
4	200	13.25
5	250	3.36

Suppose the point *p* of the boundary to be inaccessible, by means of the lines 6*p* or *p*7, being overflowed, or that of a quarry, furze, &c. might prevent your taking their lengths: in this case take the bearing of the line 6, 7, which insert opposite to the sixth station in your field-book with the other bearings; then direct the index to the point *p*, and inſert its bearing on the left side of the field-book, opposite to the sixth station, annexing thereto the words, *Int. for boundary;* and having measured and inserted the distance 6, 7, set the index in the direction of the line 7*p*, and insert its bearing on the left of the seventh station of the field-book, annexing thereto the words *Int. for boundary;* the crossing or intersection of these two bearings will determine the point *p*, and of course the boundary 6*p*7 is also determined.

If your view will then reach to the first station, take its bearing, stationary line, and off-sets, as before, and you have the field-book compleated. Thus,

The FIELD-BOOK.

Remarks and Interſect.	No. St.	Deg.	C. L.	OFF-SETS.
318 Int. to a tower	1	358	22.12	*At* 4*C*. 25*L*. *L* 1*C*. 12*L*. *at* 7*C*. 40*L*. *L*. 3*C* 4.0*L*. *at* 13*C*. *L*. 1*C*. 25*L*.
231½ Int. to ditto	2	297¾	21.12	*At* 4*C*. 10*L*. *R*. 1*C*. 20*L*. *at* 10*C*. 25*L*. *R*. 1*C*. 15*L*. *at* 13*C*. 10*L*. 0. *at* 15*C*. *L*. 45*L*.
(	3	172½	5.45	
	4	200	13.25	
	5	250	3.36	
155½ Int. for boun.	6	125	15.15	*At* 1*C*. 20*L*. *L*. 2*C*. 20*L*.: *at* 7*C*. 45*L*. *L*. 2*C*. 32*L*. *at* 11*C*. 25*L*. 0. *at* 12*C*. 25*L*. *R*. 36 *L*.
274 Int. for ditto	7	105¼	15.10	

Close at the first station.

If you would lay down a tower, house, or any other remarkable object in its proper place; from any two stations, take bearings to the object, and their intersection will determine the place where you are to insert it, in the manner that the tower is set out in the figure, from the intersections taken at the first an second stations of the above field-book.

A protraction of this will render all plain, on which lay off your off-sets and intersections, and proceed to find the content by any of the methods in section the 4th.

The foregoing field-book may be otherwise kept, thus,

Remarks and Intersections.	No. St.	Deg.	L. han. Off-set. Ch. L.	Dist. Ch. L.	R. han. Off-set. Ch. L.
318 Int. to a tower	1	358	1.12	4.25	
			3.40	7.40	
			1.25	13.00	
				22.12	
231½ Int for ditto	2	297¾		4.10	1.20
				10.25	1.15
				13.10	
			0.45	15.00	
				21.12	
	3	172½		5.45	
	4	200		13.25	
	5	250		3.36	
155½ Int. for bound.	6	125		15.15	
274 In. for boundary	7	105¼	2.20	1.20	
			2.32	7.45	
				11.25	
				12.25	[illegible].36
				15.10	

Close at the first station.

How

How to cast up off-sets by the pen.

Plate XI. fig. 2.

$$1,\ 2 - 1f, = 2f,\ 1f, - 1e = fe,\ 1e - 1d = ed.$$

Then $1d \times \frac{1}{2} da = 1da$, by prob. 6. page 183, and $\frac{1}{2} ed \times da + eb = adeb$ by the doctrine of trapezia; also $\frac{1}{2} fe \times eb + fc = befc$, and $2f \times \frac{1}{2} fc = cf2$; the sum of all which will be $1abc.21$; the area contained between the stationary line 1, 2, and the boundary, 1 *abc* 2.

In the same manner you may find the area of $2ihg2$ of $ik3i$ as well as what is without and withinside of the stationary line 7, 1.

If therefore the left hand off-sets exceed the right hand ones, it is plain, the excess must be added to the area within the stationary lines, but if the right hand off-sets exceed the left hand ones, the difference must be deducted from the said area; if the ground be kept on the right hand as we have all along supposed; or in words, thus;

To find the contents of off-sets.

1. From the distance line, take the distance to the preceding off-set, and from that the distance of the one preceding it, &c. in four-pole chains; so will you have the respective distances from off-set to off-set, but in a retrograde order.

2. Multiply the last off these remainders by $\frac{1}{2}$ the first off-set, the next by $\frac{1}{2}$ the sum of the

first and second, the next by half the sum of the second and third, the next by half the sum of the third and fourth, &c. The sum of these will be the area produced by the off-sets.

Thus, in the foregoing field book, the first stationary line is 22C. 12L. or 11C, 12L. of four-pole chains. See the figure.

	Ch. L.	Ch. L.	Ch. L.
From	11.12=1,2	6.50=1*f*	3.90=1*e*
Take	6.50=1*f*	3.90=1*e*	2.25=1*d*
	4.62=2*f*	2.60=*ef*	1.65=*ed*

Ch. L.	
1*d*=2.25×32L. half the first off-set, =	.7200
ed=1.65×1C. 26L. ½ the sum of the 1st &2d	2.0790
ef=2.60×1C. 32L. ½ the sum of 2d & 3d=	3.4320
2*f*=4.62×37L. half the last off-set =	1.7094
Content of left off-sets on the first dist. in square four-pole chains	7.9404

In like manner the rest are performed.

The sum of the left hand off-sets will be	14.0856
And the sum of the right hand ones	3.6825
Excess of left hand off-sets in squ. 4 pole C.	10.4031
Acres	1.04031
	.16124
	4
Perches	6.4496

Excess of left hand off-sets above the right hand ones, 1A. 0R. 6P. to be added to the area within the stationary lines.

OF

INTERSECTIONS.

How to find the Area of a Piece of Ground by Interſections only, when all the Angles of the Field can be ſeen from any two Stations on the Outſide of the Ground.

Plate XII. fig. 1.

LET ABCDEFGA be a field, H and I two places on the outſide of it, from whence an object at every angle of the field may be ſeen.

Take the bearing and diſtance between H and I, and ſet that at the head of your field-book, as in the annexed one. Fix your inſtrument at H, from whence take the bearings of the ſeveral angular points, A, B, C, D, *&c.* as they are here repreſented by the lines HA, HB, HC, HD, *&c.* Again fix your inſtrument at I, and take bearings to the ſame angular points, repreſented by the lines IA, IB, IC, ID, *&c.* and let the firſt bearings be entered in the ſecond column, and the ſecond bearings in the third column of your field-book; then it is plain that the points of interſection, made from the bearings in the ſecond and third columns of every line, will be the angular points of the field or the points A, B, C, D, *&c.* which points being joined by right lines, will give the plan ABCDEFGA required.

Bea. 180 Dis. 28C. of the Sta. H and I.

No.	Bear.	Bear.
A	$261\frac{1}{2}$	$331\frac{1}{2}$
B	$265\frac{3}{4}$	$317\frac{1}{4}$
C	248	$307\frac{1}{2}$
D	$238\frac{1}{4}$	289
E	$215\frac{1}{2}$	$262\frac{1}{2}$
F	$208\frac{1}{2}$	$286\frac{1}{2}$
G	220	300

The same may be done from any two stations within-side of the land, from whence all the angles of the field can be seen.

This method will be found useful in case the stationary distances, from any cause, prove inaccessible, or should it be required to be done by one party when the other in whose possession it is, refuses to admit you to go on the land.

To find the content of a field by calculation, which was taken by intersection.

In the triangle AIH, the angles AHI, AIH, and the base HI being known, the perpendicular A*a*, and the segments of the base H*a*, *AI* may be obtained by trigonometry: and in the same manner all the other perpendiculars B*b*, C*c*, D*d*, E*e*, F*f*, Gg, and the several segments at *b*, *c*, *d*, *e*, *f*, and *g*: if therefore the several perpendiculars be supposed to be drawn in the scheme (which are here omitted to prevent confusion arising from a multiplicity of lines) it is plain that if from *b*BCDE*eb*, there be taken *b*BAGF*eb*, the remainder will be the map ABCDEFGA.

As before, half the sum of B*b*, and C*c*, multiplied by *bc*, will be the area of the trapezium *b*BC*c*; after the same manner, half the sum of C*c*, and D*d*, multiplied by *cd*, will give the area of the trapezium *c*CD*d*; and again, half the sum of D*d*, and E*e* multiplied by *de*, gives the area of the trapezium *d*DE*e*; and the sum of these three trapezia will be the area of the figure *b*BCD*eb*.

Again, in the same manner, half the sum of B*b*, and *aA* multiplied by *ab*, will give the area of the trapezium *b*BA*a*; and half the sum of *a*A, and gG, by *ag*, gives the trapezium *a*AG*g*; to these add the trapezia *g*GF*f*, and *f*FE*e*, which are found in the like manner, and you will have the figure *b*BAGFE*eb*, and this taken from *b*BCD*eb*, will leave the map ABCDEFGA. Q. E. D.

It will be sufficient to protract this kind of work, and from the map to determine the area, as well as in plate X. fig. 3. to find the areas of the pieces 3, 4, 5, 6, 3, and 6, 7, 7, 6, from geometrical constructions.

How to determine the station where a fault has been committed in a field-book, without the trouble of going round the whole ground a second time.

From every fourth or fifth station, if they be not very long ones, or oftener if they are, let an intersection be taken to any object, as to any particular part of a castle, house, or cock of hay, &c. or if all these be wanting, to a long staff with a white sheet or napkin set thereon to render the object more conspicuous, and let this be placed on the submit of the land, and let the respective intersections so taken be inserted on the left hand side of the field-book, opposite to the stations from whence they were respectively taken.

In your protraction as you proceed, let every intersection be laid off from the respective stations from whence they were taken, and let these lines be continued; if they all converge or meet in one point, we thence conclude all its right, or so far as they do converge; but if we find a line of intersection to diverge or fly off from the rest, we may be sure that either a mistake has happened between the station the foregoing intersection was taken at, and the station from whence the intersection line diverges, or there must be an error in the intersection; but to be assured in which of these the fault is, protract on to the next intersection, and having set it off, if it converges with the rest, tho' the foregoing one did not, we may conclude the fault was committed in taking the last intersection but one, and none in any station, and that so far is true as is protracted; but if this as well as the foregoing intersection diverge, or fly from the point of concourse or converging point of the rest, the error must have its rise from some station or stations, at or after that, from whence the last converging intersection line was taken; so that by going to that station on the ground and proceeding on to that where the next, or from whence the following diverging intersection was taken, we can readily and with little trouble set all to rights.

But in most tracts of land, one object cannot be seen from every station, or from perhaps one fourth of them; in this case we are under the necessity to move the pole after we begin to lose sight of it, to some other part of the land, where it may be seen from as many more stations as possible; which is easily done by viewing the boundary before it be surveyed: the pole then being fixed in an advantageous place, the first intersection to it is best to be made from the same station from whence the last one was taken, and then as often as may be thought convenient, as before; in like manner the whole may be done by the removal of the pole.

When we here speak of stations, we do not mean such as are usually taken at every particular angle of the field; for it is to be apprehended, that every skilful surveyor, particularly such who use calculation, will take the longest distances possible, not only to lessen the number of stations, for the ease of either protraction or calculation, but with greater certainty to account for the land passed by, on the right hand or on the left, which is taken by off-sets: and surely it will be allowed that any measure taken on the ground and the content thence arithmetically computed, will be much more accurate than that which is obtained from any geometrical projection.

From what has been said it is plain, that from this method any fault committed in a survey can be readily determined, and therefore must be much preferable to the present method of taking diagonals, or the bearings and lengths of lines across land, to accomplish that end; which last method is too frequently used by surveyors to approximate or arrive near the content, which will ever remain uncertain, let these diagonals be ever so many, till the station or stations wherein the error, or errors were committed, be found; and the fault or faults be corrected.

Where one diagonal is taken, it may perhaps close or meet with one part of the survey and not with the other; in this case, if the surveyor would discover his error, he must survey that part of the land which did not close, and this may be half, or more, of the whole. And should the diagonal close with neither part, but be too long or too short, or should it fall on either side of the assigned point it was to close with, he ought to go over the whole, and make a new survey of it in order to discover his error.

A number of diagonals are frequently taken, the sum of the lengths of which very often exceeds the circuit of the ground, and after all they are but approximations, and the content remains uncertain as before; therefore he who returns a map, made up by the assistance of diagonals, where there remains a misclosure in any one part, runs the risque of being detected in an error, and must suffer uneasiness in his mind, as he cannot be certain of the return he makes.

The frequent misclosures which are botched up by diagonals, occasion the many and frequent scandalous broils and animosities between surveyors, which tend to the loss of character of the one or the other, and indeed often to the disrepute of both, as well as to that of the science they profess.

But these may be easily remedied by intersections, and the bearing of line be adjusted where the fault was committed, and till this be found, nothing can be certain.

To enlarge or diminish Maps.

How to enlarge or diminish a Map, or how to reduce a Map from one Scale to another; also the Manner of uniting separate Maps of Lands which join each other, into one Map of any assigned Size.

LAY the map you would enlarge, over the paper on which you would enlarge it, and with a fine protracting pin, prick thro' every angular point of your map, join these points on your paper (laying the map you copy before you) by pencilled or popped lines, and you have the copy of the map you are to enlarge: in this manner any protraction may be copied on paper, vellum, or parchment, for a fair map.

If you would enlarge a map to a scale which is double, or treble, or quadruple to that of the map to be enlarged, the paper you must provide for its enlargement must be two, or three, or four times as long and broad as the map; for which purpose in large things you will find it necessary to join several sheets of paper, and to cement them with white wafer or paste, but the former is best.

Then pitch upon any point in your copied map for a centre; from whence if distances be taken to its extreme points, and thence if those distances be set in a right line with (but from) the centre, and these last points fall within your paper, the map may be increased on it to a scale as large again as its own; and if the like distances be again set outwards in right lines from the centre, and if these last points fall within your paper, it will contain a map increased to a scale three times as large as its own, &c.

Plate XII. fig. 2.

Let the pricked or popped lines represent the copy of a down or old survey, laid down by a scale of 80 perches to an inch, and let it be required to enlarge it to one laid down by 40 to an inch.

Pitch upon your centre as ⊙, from whence thro' *a* lay the fiducial edge of a thin ruler with a fine pointed pair of compasses, take the distance from *a* to the centre O, and lay it by the ruler's edge from *a* to A: in the like manner take the distance from the next station *b* to the centre ⊙, and lay it over in a right line from *b* to B, and join the points A and B by the right line AB: in the like manner set over the distance from every station to the centre, from that station outwards, and you will have every point to enlarge to; the joining of these constantly as you go on by right lines, will give you the enlarged map required.

In taking the distances from every station to the centre, set one foot of the compasses in the station, and the other very lightly over the centre-point so lightly as scarcely to touch it, otherwise the centre-point will become so wide, that it may occasion several errors in the enlarged map: for if you err from the exact centre but a little, that error will become double, or treble, or quadruple,

druple, as you enlarge to a scale that is double, or treble, or quadruple, of the given one; therefore great accuracy is required in enlarging a map.

When you have done with a station, give a dash with a pen or pencil to it, such as at the station *a* and *b*; by this means you will be prevented from missing a station, or laying your ruler over one station twice.

From what has been said it is plain, that if a map is to be enlarged to one whose scale is double the given one, that the distances from their respective stations to the centre, being set over by the ruler's edge, will give the points for the enlarged one. And thus may a map be enlarged, from a scale of 160 to one of 80, from one of 80 to one of 40, from one of 20 to one of 10 perches to an inch, &c. For to enlarge to a scale that is double, the number of perches to an inch for the enlarged map, must be half of those to an inch for that to be enlarged: to enlarge to a scale that is treble the given one, the number of perches to an inch for the enlarged map, will be one-third of those for the other; if to a scale that is quadruple the given one, the number of perches to an inch for the enlarged map, will be one-fourth of those for the other, &c. therefore if you would enlarge a map which is laid down by a scale of 120 perches to an inch, to one of 40 perches to an inch, the distance from the several stations to the centre, being set twice beyond the said stations, will mark out the several points required, for these points will be three times further from the centre than the stationary points of the map are.

In the same manner, if you would enlarge a map from a scale of 160, to one of 40 perches to an inch, the distance from the several stations to the centre, being set three times beyond said stations, will lay out the points for your enlarged map, for these points will be four times further from the centre than are the stations of the map.

When a map is enlarged to another, whose scale is double, or treble, or quadruple, &c. of the given one, every line, as well as the length and breadth of the enlarged map, will be double, or treble, or quadruple, &c. those of the given one, for it must be easy to conceive that those maps are like: but the area, if the scale be double, will be four times; if treble, nine times; if quadruple, sixteen times that of the given figure; that is, it will contain four, nine, or sixteen times as many square inches as the given one (for it has been shewn that like polygons are in a duplicate proportion with the homologous sides.) Yet these figures being cast up by their respective scales, will produce the same content.

Thus much is sufficient for enlarging maps, and from hence, diminishing of them will be obvious; for one fourth, one third, or half the distances from the several stations to the centre, will mark out points, which if joined, will compose a map similar to the given one, whose scale will be four times, three times, or twice as small as the given one.

Thus, if we would reduce a map from 40 to 80, from 20 to 40, from 10 to 20 perches to an inch, &c. half the distance of the stations from the centre will give the points requisite for drawing the map; if we would reduce from 40 to 120, from 20 to 60, from 10 to 30 perches to an inch, &c. one third of the distances to the centre, will give the points for the map, and if we would reduce from 40 to 160, from 20 to 80, from 10 to 40 perches to an inch, &c. one fourth of the diſtances to the centre, will give the points for the map.

By the methods here laid down I have reduced a map from a ſcale of 40 to one of 20 perches to an inch, which contained upwards of 1200 acres, and conſiſted of 224 ſeparate diviſions, without the leaſt confuſion from the lines; for none can ariſe if the methods here laid down be ſtrictly obſerved.

I have alſo from the ſame methods reduced a large book of maps, each of which was an entire ſkin of parchment, and the whole contained upwards of 46000 acres, to a pocket volume; and afterwards connected all theſe maps into one map, which was contained in one ſkin of parchment: therefore upon the whole I do recommend theſe methods for reducing maps to be much more accurate than any of the methods commonly uſed, ſuch as ſquaring of paper, uſing a parallelogram. proportional compaſſes, or any other method I ever met with, though the figures to be reduced were ever ſo numerous, irregular, or complicated.

How to unite ſeparate maps of lands which join each other, into one map of any aſſigned ſize.

If there be ſeveral large maps contained in a book, each of which ſuppoſe to take up a ſkin of parchment, or a ſheet of the largeſt paper; which maps of lands join each other; and it be required to reduce them to ſo ſmall a ſcale, that all of them when joined together may be contained in one skin, half a skin, or any assigned sized piece of parchment or paper.

Having pricked off and copied the several maps on any kind of paper, unite them by cutting with scissars along the edge of one boundary which is adjoining the other, but not cutting by the edge of both, and throw aside the parts cut off; then lay these together on a large table, or on the floor, and where the boundaries agree, they will fit in with each other as indentures do; and after this manner they are easily connected; measure then the length and breadth of the entire connected maps, and the length and breadth of the parchment or paper you are confined to; if the former be three, four, or five times greater (that is, longer and broader) than the latter, reduce each copied map severally to a scale that is three, or four, or five times less, as before; and the same parts of the boundaries you cut by in the large maps, by the same you must also cut in small ones, and unite the small as the large ones were united; cementing them together with white wafer: thus will your map be reduced to the assigned size, which copy over fair, on the parchment or paper you were confined to.

But it is not always that a person is confined to a given area of parchment or paper; in such cases, if there are many large maps to be united into one, reduce each of them severally to a scale of 160 perches to an inch, and unite those by the contiguity or boundaries, as before: or if you have a few, it will be sufficient to reduce them to a scale of 120, *&c.* But having the maps given, and the scale by which they were laid down, your reason will be sufficient to direct you to know, what scale they should be reduced to.

THE

VARIATION OE THE COMPASS.

And how to find it by Amplitudes or Azimuths of the Sun.

1. IT was before observed, that the needle does not point truly to the north or south points of the horizon: the number of degrees, therefore, that the points of the needle are from the north or south points of the horizon, is called the *variation of the needle*, or *compass.*

This variation differs widely in many places; for in some, the needle will point several degrees on the west side of the north; at others there will be little or no variation, and again, at others it will point several degrees on the east side; in the same place it differs sensibly in a few years; the true cause or theory of which, has not hitherto been discovered or explained for want of a sufficient number of observations.

2. The globe of the earth revolves rounds its axis in twenty-four hours from west to east, and hence all celestial bodies seem to move from east to west.

3. The extremities of the axis are called the *poles*; the one the north or *arctic*, and the other the south or *antarctic.* And if the axis be produced to the heavens, it will point out the *celestial poles.*

4. If a circle be supposed to pass round the globe of the earth, so as to be equidiſtant from each pole, it is called the *equator*, or *equinoctial line*, and by some the *line* only.

And if the plane of the equator be produced to the heavens, it will lay out the *celestial equator*.

5. *The latitude of any place*, is its nearest distance to, and counted from the equator in degrees and minutes; and is north or south as it lies on the north or south side of the equator.

6. The poles are 90 degrees from the equator; therefore the *complement of the latitude of any place*, is the latitude taken from 90 degrees, or the distance of the place from its nearest pole.

7. *The declination of the sun*, is the nearest distance thereof from the celestial equator counted in degrees and minutes; and is north or south, as it lies on the north or south side of the equator.

8. The sun's declination taken from 90, leaves the *complement* thereof; or its distance from the nearest celestial pole.

9. *The sun's altitude*, is the number of degrees and minutes the sun is above the horizon, and is easily found by a quadrant, as before.

10. What the sun's altitude wants of 90, or the sun's distance from the *zenith*, or point of the heavens perpendicularly over you, is the *complement of the altitude*.

11. *The magnetical amplitude*, is the complement of the sun's bearing at rising or setting, taken by the quarter'd compass; on it is the number of degrees the sun is from the east or west point of the compass, at rising or setting.

12. *The true amplitude*, is the complement of degrees the sun would rise or set on if the compass did not vary; or it is the number of degrees the sun is from the east or west point of the horizon, at rising or setting; and this true amplitude is always north, if the sun's declination be north; or south if the sun's declination be south.

To find the variation by the amplitudes.

Having the latitude of the place, and the sun's declination given, the true amplitude is found by this astronomical proportion, *viz.*

As the co-sine or sine complement of the latitude,
Is to the sine of the sun's declination,
So is radius
To the sine of the true amplitude.

Then if both amplitudes be north or both south, their difference is the variation, but if one be north and the other south, their sum is the variation.

To know whether the variation be easterly or westerly.

Let the observer turn his face to the sun, then if the true amplitude be to the right hand of the magnetical one, the variation is easterly, but if to the left, westerly.

EXAMPLE I.

On the 28th day of May, 1804, the sun's bearing at rising, being N. 71°E. in the latitude 53°. 20 N. required the true amplitude, and the variation of the needle.

Find the sun's declination, by the annexed table and then to find the true amplitude, say,

As the co-sine of the latitude	53°. 20′	9.77609
Is to the sine of the declination	21°. 19′ N.	9.56536
So is radius	90°	10.00000
To the sine of the true amplitude	37°30′	9.78927

90°—71°=19° the mag. amp. from the east.
True amplitude E. 37°.30′ N. the decl. being N.
Magnetical ampl. E. 19°.00′ N.

Variation 18°.30′ W. because the true amplitude is to the left of the magnetical.

EXAMPLE II.

Suppose the sun's true amplitude is found to be W. 42°.00S. and the magnetical amplitude W. 23.00S. the sun's bearing at setting being SW. 67°. Required the variation.

90°—67°=23° the magnetical amplitude from the west.

True amplitude	W.	42°	.00′	S.
Magnetical amplitude	W.	23	.00	S.
Variation		19	.00	W.

In this case also the true amplitude is to the left of the magnetical; and therefore the variation is westerly.

EXAMPLE III.

Sun's bearing at rising being SE. $77^{\circ}\frac{1}{2}$, and the true amplitude being found to be E. 10°. 12 N. required the variation.

$90^{\circ}—77^{\circ}\frac{1}{2}=12^{\circ}\frac{1}{2}$ the magnetical amplitude from the east.

True amplitude	E.	10°.	12′	N.
Magnetical amplitude	S.	12	.30	S.
Variation		22	.42	W.

The true amplitude being still to the left, the variation is westerly.

EXAMPLE IV.

Sun's bearing at setting is SW. $81^{\circ}\frac{1}{2}$, and the true amplitude is found to be W. 6°. 16′ N. Required the variation.

$90^{\circ}-81\frac{1}{2}=8^{\circ}\frac{1}{2}$ the magnetical amplitude from the west.

True amplitude	W.	6°.	16′	N.
Magnetical amplitude	W.	8	.30	S.
Variation		14	.46	E.

The true amplitude being to the right of the magnetical, the variation is easterly.

2. *To find the variation by azimuths.*

13. The sun's magnetical azimuth is the bearing thereof at any time of the day, taken by the quartered compass; that is, counted from the north or south towards the east or west points of the box.

14. The sun's true azimuth is the point of the compass it would bear from you upon, if there were no variation; or it is the distance intercepted between the north or south points of the horizon, and a vertical circle, or circle drawn from the zenith through the sun to the horizon.

Having the latitude of the place, the sun's declination, and its altitude given, the true azimuth is obtained by the following astronomical proportion*.

1. As the tangent of half the complement of the latitude,

Is to the tangent of half the sum of the distance of the sun from the pole, and complement of the altitude,

So is the tangent of half the difference between the distance of the sun from the pole, and complement of the altitude,
To the tangent of a fourth arc.

Add this fourth arc and half the complement of the latitude together, their sum will give a fifth arc; from which if the complement of the latitude be taken, the remainder will give a sixth arc. Then say,

As radius
Is to the tangent of the altitude,
So is the tangent of the sixth arc
To the co-sine of the sun's true azimuth.

Which is counted from the north or south, to the east or west, according to the sun's situation at the time and place of observation.

If the latitude of the place, and the sun's declination be both north or both south, the declination taken from 90°, gives the sun's distance from the pole; but if one be north and the other south, the declination added to 90°, will give the sun's distance from that pole which is nearest the observer.

If both azimuths are east or west, their difference is the variation; but if one be east, and the other west, their sum is the variation.

To

To know whether the variation be easterly or westerly.

Just as with the amplitudes, let the observer's face be turned to the sun; then if the true azimuth be to the right hand of the magnetical one, the variation is easterly; but if to the left, westerly.

EXAMPLE I.

In the latitude 53°. 20′ N. the sun's declination being 19°. 03, N. I find by observation the sun's altitude to be 37°. 30′, and its magnetical azimuth to be SE. 51°. Required the variation.

90°—53.20′=36.40, the compt. of the latitude
18.20. ½ the compt. of the latitude
90°—37°.30′=52°30, the compt. of the altitude,

90°—19°.03′=70°.57′, the sun's dist. from the pole
52.30 compt. of the altitude

123.27 sum

61.43 half sum

18.27 difference

9.13 half difference

As the tang. of ½ the compt. of the latitude,	18°23′—9.52031
Is to the tangent of ½ the sum of the distance of the sun from the pole and complement of the altitude,	61.43—10.26916
: : tang. of ½ their difference	9.13—9.21022
	19.47938
To a tangent of a fourth arc.	42. 18—9.95907

Half the compt. of the latitude	18°.20′
The 4th arc	42. 18
Their sum is the 5th arc	60. 38
Complement of the lat. subtract.	36. 40
Gives the 6th arc	23. 58

As radius	90°.00′—10.00000
Is to the tang. of the alt.	37.30— 9.88498
: : tangent of the 6th arc	23.58— 0.64790
Co-sine of the sun's true azim.	70.04— 9.53288

True azimuth	S. 70°.04′ E.
Magnetical azimuth	S. 51.00 E.
Variation	19.04 W.

The true azimuth being to the left of the magnetical one, the variation is westerly.

EXAMPLE II.

Suppose the sun's true azimuth N. 83°. 20′ E. but the magnetical one N. 70°.30′ E. Required the variation.

True azimuth	N. 83°.20′ E.
Magnetical azimuth	N. 70. 30 E.
Variation	12. 50 E.

The true azimuth being to the right of the magnetical one, the variation is easterly.

EXAMPLE III.

Suppose the sun's true azimuth was S. 37°. 15 W. and the magnetical one S. 44°.20 W. Required the variation.

True azimuth	S. 37°. 15′ W.
Magnetical azimuth	S. 44. 20 W.
Variation	7. 05 W.

The true azimuth being to the left of the magnetical one, the variation is westerly.

EXAMPLE IV.

Suppose the sun's true azimuth be S. 4° 05′ W. and the magnetical one S. 3° 30 E. Required the variation.

True

True azimuth	S. 4°.05′ W,
Magnetical azimuth	S. 3. 30 E.
Variation	7. 35 E.

The true azimuth being to the right of the magnetical, the variation is easterly.

The variation of the compass was first observed at London in the year 1580, to be one point of the compass easterly, or 11°.15′ E. after which time it became less; for in the year 1622 it was 6°.00′ E. in 1634 is was 4°.05′ E. and so continued to decrease till the needle coincided with the true meridian, and then there was no variation; after which the variation became westerly, and has ever since increased to the westward: for in the year 1672 it was 2°.33′ W. in the year 1683 it was 4°.30 W. at London; in 1722 it was at Dublin found to 11° 15′ W. and in 1751 it was there found to be 19°.00′ W. At London, in the year 1800, it was about 23° 30′, and still continues to increase westerly at the rate of 11 or 12′ every year.

At Paris in 1640, the variation was 3°.00′ E. in 1666 there was no variation; but in 1681 it was 2° 30′ W. and still continues to go on westerly.

How to draw a true meridian line to a map, having the variation and magnetical meridian given.

On any magnetical meridian or parallel, upon which your map is protracted, set off an angle from the north towards the east, equal to the degrees or quantity of variation, if it be westerly, or from the north towards the west if it be easterly, and the line which constitutes such an angle with the magnetical meridian, will be a true meridian line.

For if the variation be westerly, the magnetical meridian will be the quantity of variation of the west side of the true meridian, but if easterly on the east side, therefore the true meridian must be a like quantity on the east side of the magnetical one, when the variation is westerly, and on the west side when it is easterly.

How to lay out a true meridian line by the circumferentor.

If the variation be westerly, turn the box about till the north of the needle points as many degrees from the flower-de-luce towards the east of the box, or till the south of the needle points the like number of degrees from the south towards the west, as are the number of degrees contained in the variation, and the index will be then due north and south; therefore if a line be struck out in the direction thereof, it will be a true meridian line.

If the variation was easterly, let the north of the needle point as many degrees from the flower-de-luce towards the west of the box, or let the south of the needle point as many degrees towards the east, as are the number of degrees contained in the variation, and then the north and south of the box will coincide with the north and south points of the horizion, and consequently a line being laid out by the direction of the index, will be a true meridian line.

This will be found to be very useful in setting an horizontal dial, for if you lay the edge of the index by the base of the stile of the dial, and keep the angular point of the stile towards the south of the box, and allow the variation as before, the dial will then be due north and south, and in its proper situation; provided the plane upon which it is fixed be duly horizontal, and the sun be south at noon; but in places where it is north at noon, the angular point of the index must be turned to the north.

How maps may be traced by the help of a true meridian line.

If all maps had a true meridian line laid out upon them, it would be easy by producing it, and drawing parallels, to make out field-notes; and by knowing the variation, and allowing it upon every bearing, and having the distances, you would have notes sufficient for a trace. But a true meridian line is seldom to be met with, therefore we are obliged to have recourse to the foregoing method. It is therefore advised to lay out a true meridian line upon every map.

How to find the difference between the present variation, and that at a time when a tract was formerly surveyed, in order to trace or run out the original lines.

If the old variation be specified in the map or writings, and the present be known, by calculation or otherwise, then the difference is immediately seen by inspection; but as it more frequently happens, that neither is certainly known, and as the variation of different instruments is not always alike at the same time, the following practical method may be very useful, *viz.*

Go to any part of the premiſes where any two adjacent corners are known; and if one can be seen from the other, take their bearing; which compared with that of the same line in the former survey, shews the difference. But if trees, hills, *&c.* obstruct the view of the object, run the line according to the given bearing, and observe the nearest distance between the line so run and the corner; then

As the length of the whole line
Is to 57.3 degrees*
So is the said distance
To the difference of variation required.

EXAMPLE.

Suppose it be required to run a line which some years ago bore NE. 45°, distance 80 perches, and in running this line by the given bearing, the corner is found 20 links to the left hand; what allowance must be made on each bearing to trace the old lines, and what is the present bearing of this particular line by the compass?

```
      P.       Deg.        L.
As   80  :   57.3   : :   20
     25        20
    ----     -------
    2|000    1146.0(0°. 34′.
                  60
             -------
           2)68.760.0
             -------
```

Answer 34 minutes, or a little better than half a degree to the left hand, is the allowance required, and the line in question bears N. 44°. 26′.E.

Note, The different variations do not affect the area in the calculation, as they are similar in every part of the survey.

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* 57.3 is the radius of a circle (nearly) in such parts as the circumference contains 360.

A Table of the Sun's Declination.

Days.	Jan		Feb.		March.		April.		May.		June.	
	South.		Sout		South.		North.		North.		North.	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
For the Years 1808, 1812, 1816, 1820,												
3	22	55	16	47	6	46	5	21	15	42	22	20
7	22	30	15	35	5	14	6	52	16	50	22	46
11	21	57	14	18	3	40	8	21	17	54	23	6
15	21	18	12	58	2	5	9	48	18	53	23	20
19	20	31	11	35	0S.	30	11	13	19	47	23	27
23	19	39	10	9	1N.	5	12	35	20	36	23	27
27	18	41	8	40	2	38	13	53	21	19	23	21
For the Year 1809, 1813, 1817, 1821,												
3	22	51	16	33	6	52	5	15	15	38	22	18
7	22	24	15	21	5	19	6	46	16	46	22	45
11	21	50	14	4	3	46	8	16	17	50	23	5
15	21	9	12	43	2	11	9	43	18	50	23	19
19	20	22	11	19	0S.	36	11	7	19	44	23	27
23	19	29	9	52	0N	58	12	29	20	33	23	27
27	18	30	8	23	2	33	13	47	21	17	23	22
For the Years 1810, 1814, 1818, 1822,												
3	22	52	16	38	6	58	5	10	15	33	22	16
7	22	26	15	25	5	25	6	41	16	42	22	44
11	21	52	14	8	3	51	8	10	17	47	23	4
15	21	12	12	48	2	17	9	37	18	46	23	19
19	20	25	11	24	0S.	42	11	2	19	41	23	26
23	19	32	9	58	0N.	53	12	24	20	30	23	27
27	18	33	8	29	2	27	13	42	21	14	23	22
For the Years 1811, 1815, 1819, 1823,												
3	22	54	16	42	7	3	5	4	15	29	22	15
7	22	28	15	30	5	31	6	35	16	38	22	42
11	21	54	14	13	3	57	8	5	17	43	23	3
15	21	15	12	53	2	23	9	32	18	43	23	18
19	20	28	11	29	0S.	48	10	57	19	38	23	26
23	19	35	10	3	0N.	47	12	19	20	27	23	28
27	18	37	8	34	2	21	13	38	21	12	23	23

A Table of the Sun's Declination.

	Each being Leap Year.											
Days.	July.		August		Sept.		Oct.		Nov.		Dec.	
	North.		North.		North.		South.		South.		South.	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
3	22	59	17	32	7	33	3	59	15	7	22	9
7	22	37	16	27	6	4	5	32	16	20	22	39
11	22	8	15	17	4	33	7	4	17	28	23	2
15	21	33	14	4	3	1	8	33	18	32	23	18
19	20	52	12	47	1N.	28	10	1	19	31	23	26
23	20	6	2	27	0S.	5	11	27	20	23	23	27
27	19	14	10	5	1	39	12	49	21	10	23	[illegible]
	Each the first Year after Leap-Year.											
3	23	0	17	36	7	39	3	53	15	2	22	6
7	22	38	16	31	6	10	5	26	16	15	22	37
11	22	10	15	22	4	39	6	57	17	24	23	1
15	21	36	14	9	3	7	8	27	18	28	23	17
19	20	55	12	51	1	34	9	56	19	27	23	26
23	20	9	11	32	0N.	1	11	21	20	20	23	27
27	19	18	10	10	1S.	33	12	44	21	8	23	21
	Each the second Year after Leap-Year.											
3	23	2	17	39	7	44	3	48	14	57	22	4
7	22	40	16	35	6	15	5	20	16	11	22	36
11	22	12	15	26	4	44	6	52	17	20	23	0
15	21	38	14	13	3	12	8	22	18	25	23	16
19	20	58	12	57	1	40	9	50	19	24	23	26
23	20	12	11	37	0N	6	11	16	20	17	23	28
27	19	21	10	15	1S.	28	12	40	21	5	23	22
	Each the third Year after Leap-Year.											
3	23	3	17	43	7	49	3	42	14	55	22	2
7	22	41	16	39	6	20	5	15	16	7	22	34
11	22	14	15	30	4	50	6	47	17	16	22	58
15	21	40	14	18	3	18	8	17	18	21	23	16
19	21	0	13	2	1	45	9	45	19	20	23	25
23	20	15	11	42	0N.	12	11	11	20	14	23	28
27	19	24	10	20	1S.	22	12	35	21	2	23	22

Some Necessary Directions concerning Surveys in general.

If you have a large quantity of ground to survey, which consists of many fields or holdings, and that it be required to map and give the respective contents of the same, it is best to make a survey of the whole first, and to be satisfied that it is truly taken, as well as to find its content; and as you go round the land, to make a note on the side of your field-book at every station where the boundary of any particular field or holding intersects or meets the surround; then proceed from any one of those stations, and in your field-book, say, "proceed from such a station" and when you have gone round that field or division, insert the station you close at, and so through the whole: a little practice can only render this sufficiently familiar, and the method of protraction must be evident from the field-notes. When the whole is protracted, and you are satisfied of the close of the particular divisions, cast up each severally, and if the sum of their contents be equal to the content of the whole first found, you may safely conclude that all is right.

The protraction being thus finished and cast up, transfer it on clean paper, vellum, or parchment, as before; be careful to draw your lines with a fine pen, write on it the names of the circumjacent lands, and set No. 1, 2, 3, 4, *&c.* in every particular field or division; let every tenant's particular holding be distinguished by a different coloured paint being run finely along the boundaries; let all the roads, rivulets, rivers, bridges, bogs, ponds, houses, castles, churches, beacons, (or whatever else may be remarkable on the ground) be distinguished on the map. Write the title of the map in a neat compartment either drawn, or done from a good copper-plate graving, with the gentleman's arms. Prick off one of your parallels with the map, and on it make a mariner's compass, and draw a flower-de-luce to the north, and this will represent the magnetical north ; after which set off the variation, which express in figures, and through the centre of the compass, let a true meridian line be drawn of about 3 inches long, by which write True Meridian. Let a scale be drawn : or it is sufficient to express the number of perches to an inch, the map was laid down by. Draw a reference table of three, or if occasion be, of four or more columns : in the first insert the number of the field or holding : in the next its name, and by whom occupied : in the third the quantity of acres, roods, and perches it contains : if you have unprofitable land, as bog or mountain, let the quantity be inserted in the fourth column ; and, if it be required, you may make another column for statute measure, and then the map is completed.

SECT. VII.

The method of dividing land or of taking off or inclosing any given quantity.

EXAMPLE.

Plate XII. fig. 1.

Let ABCD, *&c.* be a map of ground, containing 11 acres, it is required to cut off a piece as DEFGID, that shall contain 5 acres.

Join any two opposite stations as D and G, with the line DG (which you may nearly judge to be the partition line) and find the area of the part DEFG, which suppose may want 3R. 20P. of the quantity you would cut off: measure the line DG, which suppose to be 70 perches. Divide 3R. 20P. or 140P. by 35, the $\frac{1}{2}$ of DG, and the quotient 4 will be a perpendicular for a triangle whose base is 70, and the area 140P. Let IH be drawn parallel to DG, at the distance of the perpendicular 4, and from I, where it cuts the boundary, draw a line to D, and that line DI will be the division line; or a line from G to H will have the same effect; all which must be evident from what has been already said.

But if hills, trees, &c. obstruct the view of the points D and I from each other, it will be necessary, in order to run the partition line, to know its bearing; and it may be proper on some occasions, to have its length; both these may be easily calculated from the common field-notes only, as in the following examples, without the trouble of any other measurement on the ground, or any dependence on the map and scale.

EXAM-

EXAMPLE II.

Plate XII. fig. 3.

Let ABCDEFGHIA be a tract of land, to be divided into two equal parts, by a right line from the corner I to the opposite boundary CD; required the bearing and length of the partition line IN, by calculation, from the following field-notes, *viz.*

Field-Notes and Area.

Bound.	Bearing.	Perch.
AB	N. 19°. 0′ E.	108.
BC	S. 77. 0 E.	91.
CD	S. 27. 0 E.	115.
DE	S. 52. 0 W.	58.
EF	S. 15. 30 E.	76.
FG	West.	70.9
GH	N. 36. 0 W.	47.
HI	North.	64.3
IA	N. 62. 15 W.	59.
	152A. 1R. 45.9P.	

Operation.

IABCI.		Per.	N.	S.	E.	W.	Merid. dist. &c.
IA	N. 62°¼W.	59	27.5	—	—	52.2	
AB	N. 19 E.	108	102.4	—	35.2	—	
BC	S. 77 E.	91	—	20.5	88.7	—	
CI	—	—	—	109.1	—	71.7	
Area, 8722.3 perch.			129.6	129.6	123.9	123.9	

152A. 1R. 25.9P. = 24385.9 perch.
half, to be divided off, = 12192.9 } subt.
the part I A B C I = 8722.3 }

Triangle I C N I = 3470.6 perch.

ICDI.

ICDI.		Per.	N.	S.	E.	W.	Mer. dis. &c.
IC	N. —— E.	——	109.1	——	71.7	——	
CD	S. 27. E.	115	——	102.5	52.2	——	
DI	——	——	——	6.6	——	123.9	
Area, 6522.1 per.			109.1	109.1	123.9	123.9	

Then, { I C D I : CD : : I C N I : CN } Th. 18
as { 6522.1 : 115 : : 3470.6 : 61.19 } Sec. 1
which determines the point N in CD.

ICNI.		Per.	N.	S.	E.	W.
IC	as before	——	109.1	——	71.7	——
CN	S. 27 E.	61.2	——	54.5	27.8	——
NI	——	——	——	54.6	——	99.5

As dif. lat.	54.6	As S. Bear.	61°15′
: Radius S.	90 deg.	: Depart.	99.5
: : Depart.	99.5	: : Radius S.	90 deg.
: Tang. Bear.	61°15′	: Distance	113.49

Answer, { IN runs N. 61° 15 E. } 113.5 per.
{ NI runs S. 61 15 W. }

In the part IABCI, the difference between the northings and the southings of the three lines, IA, AB and BC (109.1) is the difference of latitude, and that of their eastings and westings (71.7) the departure of the line CI, which is placed thereto, so as to balance the columns; see theo. 1. sect. V. hence the content is obtained, as already taught, without the bearing or length of the line CI.

For the triangle ICDI, the diff. lat. and dep. of IC are taken from the preceding table, which in going from I to C will be northing and easting; those of CD are found by the bearing and distance, and of DI by balancing the columns, as before for CI.

The difference of latitude (54.6) and departure (99.5) of the line NI in the third table, are found by balancing those of IC and CN and as they are the base and perpendicular of a right angled triangle, of which the line NI is the hypothenuse, and the angle opposite to the departure, the bearing, we have the answer by two trigonometrical statings, as above; and thus may any tract be accurately divided, or any proposed quantity readily cut off or inclosed.

Now, the student or practitioner may calculate the content of the part ABCNIA (the bearing and distance, or the diff. lat. and dep. of CN and of NI being known) and if it be found equal to the intended quantity, it proves the truth of the operation.

EXAMPLE III.

Plate XII. fig. 3.

It is proposed to cut off 38A. 16½P. to the south end of this tract, by a line running from E due West 40 perches to a well at O, and from thence a right line to a point M in the boundary HI; the place of M, and the bearing and length of the line OM are required; the field-notes being as in example 2d.

Answer, { M from H, north, 43.23 / OM, N. 78° 7′ W. 39.03 } perches.

In this example we find,

		Perches
The area of	OEFGHO =	5270.5
Consequently of	HOMH =	826.0
Dif. lat. of the line	HO=HV =	35.2
Departure of ditto	=OV =	38.2

As HI happens to be a meridian, the area of HOMH divided by half OV (19·1) quotes HM (43.23) without finding the area of HOIH, as we did of ICDI in example 2d. and HM — HV = VM = 8.03 = diff. lat. of OM, which with its dep. VO = 38.2, gives the bearing and distance as before.

EXAMPLE IV.

Plate XII. fig. 4.

A trapezoidal field ABCD, bounded as under specified, is to be divided into two equal parts by a right line EF parallel to AB or CD; required AF or BF.

Bou.	Bearing.	Per.
AB	South.	30.
BC	N. 80 W.	60.
CD	N. 39½ W.	45.5
DA	S. 80 E.	89.4
13A. 3R. 7P.		

In the triangle CBG are given BC and all the angles (known by the bearings) to find BG, and thence the area by prob. 9. sect. 4. which + half the area of ABCD=area of EFG; then, as the area of CBG to that of EFG, so is the square of BG to the square of FG, and FG—BG=BF.

Operation at large.

Angle G 39° 30′, log. S. Co. Ar.	0.19649	
Side BC 60 per log.	1.77815	add
Angle C 40° 30′, sine	9.81254	
Side BG 61.26 per.	1.78718	
Side BC 60 per.	1.77815	add
Angle B 100° 0′, sine	9.99335	
2)3619.8, log.	3.55868	
As CBG = 1809.9 Co. Ar.	6.74235	
1103.5=BCEF		
To EFG = 2913.4, log.	3.46440	add
So sqr. BG 61.26, log.	1.78718	
	1.78718	
To sqr. FG 77.72	(2)3.78111	
Ansr. BF=16.46 per.	1.89055	

By the application of this method a tract of land may be divided accurately, in any proportion, by a line running in any assigned direction.

Note. When the practitioner would wish to be very accurate, it will be much better to work by four-pole chains and links than by perches and tenths; one tenth of a perch square being equal to 6¼ square links.

EXAMPLE V.

The following Field-Notes (from A. Burns) *are of a piece of land, which is proposed, as an Example, to to be divided into three equal parts, by two right-lines running from the sixth and seventh stations; and proved, by calculating the content of the middle part.*

St.	Bearing.		4P.C.
1	N.E.	56°¼	21.60
2	N.E.	26½	13.44
3	S.E.	71½	18.96
4	S.E.	26½	13.44
5	S.W.	71½	18.96
6	S.E.	45	8.47
7	S.E.	63½	13.44
8	N.E.	45	8.47
9	S.E.	26½	13.44
10	S.W.	45	8.47
11	S.W.	63½	13.44
12	N.W.	76	24.73
13	N.W.	36¾	30.00

	A.	R.	P.
Area	167.	1.	24.

EXAM

EXAMPLE VI.

Plate VIII. fig. 5.

The plot ABCDEFGHA is proposed to be divided, *geometrically*, in the proportion of 2 to 3, by a right-line from a given point in any boundary or angle thereof, suppose the point D.

Reduce the plot to the triangle cDe, as already taught; divide the base ce in the point N, so that eN be to Nc in the ratio of two or three, by prob. 14. page 53; draw DN, and it is done.

EXAMPLE. VII.

Plate XII. fig. 3.

Example 2d. may likewise be performed geometrically.

Produce CD both ways for a base, and reduce the whole to a triangle, making I the vertical point; then bisect the base in N, and draw IN. But,

Notwithstanding this geometrical method is demonstrably true in theory, it is not as safe, on practical occasions requiring accuracy, even when performed with the greatest care, as that of calculation; for which reason we will not enlarge on it here.

EXAMPLE VIII.

Suppose 864 *acres to be laid out in form of a right-angled parallelogram, of which the sides shall be in proportion as* 5 *to* 3 *; required their dimensions.*

For the greater side, multiply the area by the greater number of the given proportion, and divide by the less; or, for the less side, multiply by the less number, and divide by the greater; the square-root of the quotient will be the side required; thus,

$$\begin{array}{rr} 364\text{A.} = 138240\text{ P.} & 138240 \\ 5 & 3 \\ \hline 3)691200 & 5)414720 \\ \hline \end{array}$$

Answ. $\surd\, 230400 = 480.$ $\surd\, 82944 = 288.$

EXAMPLE IX.

If it be required to lay out any quantity of ground, suppose 47A. 2R. 16P. in form of a parallelogram, of which the length is to exceed the breadth by a given difference, for instance 80 perches, then, add the square of half this difference to the area, and take the square-root of the sum; to which add half the difference for the greater side, and subtract it therefrom for the less; thus,

$$\begin{array}{rr} 2)80 & 47\text{A. } 2\text{R. } 16\text{P.} = 7616 \text{ perches.} \\ \hline & 1600 \\ 40 & \\ 40 & \hline \\ \hline & \surd 9216 = 96 \\ 1600 & \text{half dif. add and subt.} - 40 \\ & \hline \end{array}$$

$$\text{Answ.} \begin{cases} \text{the length} = 136 \\ \text{the breadth} = 56 \end{cases}$$

Any proposed quantity of ground may be laid out or inclosed in the form

$$\text{of a} \left\{ \begin{array}{ll} \text{Square - - -} & \text{by prob. 2d} \\ \text{Parallelogram, 1 side giv.} & \text{by pro. 4th} \\ \text{Triangle of a given base,} & \text{by pro. 7th} \\ \text{Circle -} & \text{by prob. 13th} \end{array} \right\} \text{sec. IV.}$$

R.

It is sometimes most convenient, when land is to be laid out adjacent to a creek, river, or other crooked boundary, to measure off-sets to the angles or bendings thereof, from a right-line or lines taken near such boundary, and to deduct the area of these off-sets from the given quantity, and then to lay off the remainder from the right-line or lines, in the desired form.

In laying out new lands, attention must be paid to the allowance for roads, as exemplified in prob. 14th, page 195.

EXAMPLE X.

It is required to divide off 30 acres, to the south east end of the tract, of which the field-notes are given in example 4th, by a right-line, to run N. 20° E. See example 4th.

SECT. VIII.

Containing the Surveying of Harbours, &c. and Levelling.

Of surveying Harbours, Shoals, Sands, &c.

Plate XIII. fig. 1.

THERE are three methods whereby this may be performed; for the observations may be made either on the water or on the land. Those made on the water are of two kinds, one by the log-line and compass (as in plane sailing) measuring the course and distance round the sand; and then to be plotted as a large wood, or any enclosure taken by the circumferentor.

This method I omit for two reasons; first, because it is to be deducted from the writers on navigation: and, secondly, because the distances thus measured are liable to the errors of currents, which generally attend shoals or sands near the shore.

The second method, where there are no distances to be measured on the water, tho' still there is one inconvenience, common also to the former, because the bearings or observations are to be taken on that unstable element (an error scarce mentioned ed by practical artists) I shall briefly hint at; and so rather choose a third, which is liable to neither of these imperfections.

Let a boat be manned out with a signal flag, a log and line, lead and line, and to observe the bearings of any land mark, a compass with sights.

Take two or more objects or places, as A, B, C, on the shore, from whence the boat may be seen on the several parts of this shoal, and determine their relative position by bearing and distances, either before or after the other necessary observations are made.

One of the boat's crew is to sound till he finds himself on the edge of the sand by the depth of water, and then to come to an anchor; which he is to signifiy to two persons on the shore, at B and C, by his signal. And then from those known land-marks, B and C, the observers are to take the bearings of the boat, and to register their observations; which, when done, they are to signify to the crew by waving a flag, or by some other signal.

And in the mean time, to prevent mistakes, let the crew take the bearings of each of these land-marks: then weigh anchor, which suppose at D.

Then, by sounding, proceed to E, and make like observations. And so at E, F, G, *&c.* till you have surrounded your sand.

And if in this process, you are about to lose the sight of one of your land marks, suppose C, let your assistant at C, or B, who at that time will also be about to lose the sight of the boat, by signals (before agreed on) remove to some other object before-hand agreed on, suppose to H, or K; and then to proceed as before.

Lastly, if the sand runs so far out to sea, that the object cannot be seen from the boat, nor the boat by the observer on shore; there may be rockets fired by the boat's crew, and also by the observers on shore in the night, whereby those bearings may be taken almost at as great a distance as the light can be seen. For supposing they rise but a quarter of a mile above the apparent horizon, its stay will be about 9 seconds, and its distance for this quarter of a mile will be visible about 44 miles.

But rockets rise much higher, and then the distances are much greater, whereby they are visible.

Or two boats may lie at anchor instead of the land-marks, and then you may work as before.

Now, since the land marks B and C are fixed, their position may be laid down in the draught, as in common surveying, by plotting the distance between B and C. And then, by plotting the line BD, and the line DC, according to their position, their common intersection, will give the point D. And in like manner E, F, G, *&c.* may be plotted; and so the shoals completed: And this from the bearings taken at B and C.

If this be a standing lake, environed by bogs, or other impediments, the observations at D, E, F, *&c.* by taking their opposites, may suffice to plot the same from the land-marks, A, B, C, *&c.* as well as those taken on the land; or, indeed, by the course and distance, as in navigation, if the water be smooth and without a current.

In sea shoals it is convenient to note at each observation the depth of the water found by the lead, and the drift and setting of the current by the log and compass, while the boat is at anchor, which may be done with ease and expedition enough. For while the boat rides at an anchor, her stern points out the setting of the current, and the log and glass will measure its drift.

And these ought to be noted on the draught, which may be thus:

The currents may be shewn, by drawing a dart pointing out its setting, and its drift by the Roman capital letters, the depth of water by the small figures, and rocks by little crosses, &c.

LEVELLING.

Plate XIII. fig. 2.

LEVELLING is the art of ascertaining the perpendicular ascent or descent of one place (or more) above or below the horizontal level of another, for various intentions; and of marking out courses for the conveyance of water, &c.

The *true level* is a curve conforming to the surface of the earth; as ABG.

The *apparent level* is a tangent to that curve; as ADE.

The *correction*, or allowance for the earth's curvature, is the difference between the apparent level and the true, as BD. The quantity of this correction may be known by having, in the right-angled triangle CAB, the two legs, AC=the semidiameter of the earth (=1267500 perches) and AD=the distance of the object, to find the hypothenuse CD, from which taking CB (=CA) the remainder will be the correction BD; but it may be obtained more practically, thus:

Square the distance in

four-pole chains and divide by 800,
or in perches and divide by 12800,
or in miles and multiply by 8,
for the correction in inches.

EXAMPLE.

Required the correction for 20 four-pole chains =80 perches=$\frac{1}{4}$ mile.

$800)20\times20=400(.5$
$12800)80\times80=6400(.5$
$\frac{1}{4}=.25$, and $.25\times.25\times8=.5$
that is .5, or $\frac{1}{2}$ inch, the correction required.

But, to save the trouble of calculation, we insert the following Table of Corrections.

A Table.

A Table of Corrections.

The distances in four-pole chains.

Distan.	Correc.	Distan.	Correc.
Chains.	Inches.	Chains.	Inches.
1	0,00125	27	0,91
2	0,005	28	0,98
3	0,01125	29	1,05
4	0,02	30	1.12
5	0,03	31	1,19
6	0,04	32	1,27
7	0,06	33	1,35
8	0,08	34	1,44
9	0,10	35	1,53
10	0,12	36	1,62
11	0,15	37	1,71
12	0,18	38	1,80
13	0,21	39	1,91
14	0,24	40	2,00
15	0,28	45	2,28
16	0,32	50	3,12
17	0,36	55	3,78
18	0,40	60	4,50
19	0,45	65	5,31
20	0,50	70	6,12
21	0,55	75	7,03
22	0,60	80	8,00
23	0,67	85	9,03
24	0,72	90	10,12
25	0,78	95	11,28
26	0,84	100	12,50

The first thing necessary in levelling, is the adjusting of the level, which may be performed several ways. The following is very easy and practical.

Choose some ground which is not above 4 or 5 feet out of the level, for the distance of 8 or 10 chains length, and suppose it be AB (fig. 3.) and find the middle between A and B, which suppose to be C; plant the instrument at C; direct the tube to a station-staff, held up at A, and elevate or depress the tube, till the bubble is exactly in the middle of the divisions; then by signals direct your assistant at A, to raise or depress the vane, sliding on the station-staff, till the horizontal hair in the glass, cuts the middle of that vane: then see how many feet, inches, and parts, are cut by the upper part of the vane, which suppose to be 3 feet 4 inches and 6 tenths.

In like manner direct to the other staff, at B, and suppose the upper edge of that vane to cut at the height of 6 feet 5 inches and 2 tenths; then will these two vanes be on a level.

From 6 feet 5.2 inches subtract 3 feet 4.6 inches and reserve the remainder 3 feet 0.6 inches.

Now remove the instrument as close to the higher station-staff as you can; so that the middle of the telescope may almost touch it. Then bring the telescope as near to a level as the judgment of the eye will direct.

Measure from the ground, the height of the top of the telescope; and also of the bottom, in feet inches, and parts: Suppose them to be 4 feet 10.5 inches, and 5 feet 0.3 inches; then half the sum of these heights 4 feet 11.4 inches is the height of the centre of the glass; and to this add half the breadth of the vane, which suppose to be 1 inch and 5 tenths, and to the sum 5 feet 0.9 inches, add the preceding remainder 3 feet 0.6 inches; then let the person at B move his vane, till the upper edge cut 8 feet 1.5 inches, the sum of the preceding numbers.

Now, so elevate or depress the hair or the bubble, till the hair cut the middle of the vane at B, and at the same time the bubble stands in the middle of the divisions; and then will the instrument be duly adjusted.

If you have a mind to be more accurate, repeat the operation; but when you place the instrument at C, turn the tube at right angles to the line AB, and there set it level; then proceed with the repetition of the work. Only observe to cross-level it in this adjustment, and in all future uses whatsoever.

Or the level may be adjusted thus: As before, first plant the instrument in the middle between A and B (fig. 4.) and observe the heights on the station-staves, which suppose to be as above; and consequently their difference, as before, is 3 feet 0.6 inches. Now measure from C towards the highest ground A, some distance that comes almost to A; suppose 4 chains to D, and DB will be 9 chains, and DA one chain: Then plant the instrument at D, direct the telescope to A, and, setting the bubble to the middle of the division, direct your assistant to move the vane, till the hair cuts the middle of it; and note down the feet, inches, and parts cut by the upper edge of the vane; which suppose to be 3 feet 8.4 inches: To this add the difference 3 feet 0.6 inches, and the sum 6 feet 9 inches reserve.

Now direct the telescope to the staff at B, level it, and direct your assistant to move the vane, till the hair cuts the middle thereof; and then, if the upper edge of the vane cuts the foregoing sum 6 feet 9 inches, the hair and bubble are truly adjusted. But if not, say, As BD less AD, is to the difference between the numbers cut by the upper edge of the vane, and the number 6 feet 9 inches; so is the distance AD to a number, which added to that cut by the vane, when less than 6 feet 9, and subtracted from the number cut by the vane, when it is greater than 6 feet 9, will give a number to which let the assistant fix the vane; then so elevate or depress the hair or the bubble, till the hair cuts the middle of the vane at B, and the bubble stands in the middle of the divisions; for then the level will be adjusted. The operation may be again repeated, and at every station cross-levelled, which will confirm the former adjustment.

Or it will be still better to set the station-staves equally distant from the instrument (suppose about 16 or 20 perches each) at an angle of about 60° or so as to form nearly an equilateral triangle therewith, and level the 2 vanes (A and B fig. 5) as before, which will be then both in the same horizontal level, whether the instrument be right adjusted or not, because one will be as much above or below the true level of the instrument, as the other, being at the same distance from it; then remove the instrument as near as may be to one of them, suppose A, and raise or lower the vane A to the exact level of the visual ray in the instrument, noting precisely how much it is moved, and have the other vane B moved just as much in order to bring them again to a level, allowing for the correction of the apparent level if it be a sensible quantity, then adjust the instrument to the level of the vane at B.

To adjust the rafter level (plate 13. fig. 6.) which may be 10, 12 or 14 feet in the span AB; set it on a plank or hard ground nearly level, and mark where the plumb lines cuts the beam mn, suppose at c, then invert the position by setting the foot A in the place of B, and B in that of A marking where the line now cuts as at *e*; the middle point between *c* and *e* will be the true levelling mark.

To continue a level course with this instrument, set the foot A to the starting place, and move B upward or downward toward D or F, till the point B be determined and marked for a level with A, then carry the instrument forward in the direction of C till the foot A rests at B, whence the point C is levelled as before, &c. Sights may be placed at *r* and *s* and the instrument adjusted to them, as before, by reversing them in the direction of some distant object.

After the instrument is duly adjusted, you may proceed to use it. Let the example be this annexed (fig. 7.) where A every where represents the level, and B the station-staves; and suppose the route be made from *a* to *e*; first plant the instrument between the staves *a* and *b*: at A direct the level to *a* B, bring the bubble to the middle of the divisions, and instruct your assistant so to place the vane, that the hair in the telescope cuts the middle of the vane; then in a book divided into two columns, the one intitled *Back Sights*, the other *Fore Sights*, enter the feet, inches, and parts cut by the upper edge of the vane at *a* B, in the column intitled *Back Sights*.

Then look towards the other staff *b* B, bring the bubble to the middle of the divisions, and direct your assistant to place the vane so, that the hair cuts the middle of the vane; then enter the feet, inches, and parts cut by the upper edge of the vane in the column of *Fore Sights*.

Now, plant the instrument at A', still keeping the staff B*b* exactly in the same place, and carry the staff *a*B forwards to the place *c*B; now look back to the (staff *b*B, and enter the numbers cut by the vane there, under the title *Back Sights*; then look forwards to *c*B, and enter the observation under the title *Fore Sights*. Do the like when the instrument is planted at A', A', *&c.* always taking care to keep the staff in the same place when you look'd at it for a *Fore Sight*, till you have also taken with it a *Back Sight*.

Having finished your level, add up the column of *Back Sights* into one sum, and the column of *Fore Sights* also into one sum; and the difference between these sums is the ascent or descent required. And if the sum of the *Fore Sights* be greater than the sum of the *Back Sights*, then *e* is lower than *a*; but if the sum of the *Fore Sights*, be less than the sum of the *Back Sights*, *e* is higher than *a*. For example, let the numbers be as in the following table:

Back Sights.			*Fore Sights.*		
Feet.	Inch.	Tenths	Feet.	Inch.	Tenths.
3	7	5	6	4	5
4	6	8	8	3	2
6	0	2	5	4	7
9	5	0	8	7	8
1	0	7	9	4	8
24	8	2	38	1	0
			24	8	2
			13	4	8
Hence the descent is			13	4	8

Some

Some observations to be noticed.

1. And if the distances thus taken are short, the curvature of the earth may be rejected. For if the distance from the instrument be every where about 100 yards, all the curvatures in a mile's work will be less than half an inch.

2. If the distances from the instrument to the hindermost staff, be every were equal to the distance from the instrument to the corresponding staff; the curvature of the earth, and the minute errors of the instrument will both be destroyed. Hence it will be much best to set the instrument as equally distant from both staves as may be.

3. If the distances of the instrument from the staves, be very unequal and very long, the curvatures must be accounted for, and the distances, in order thereto, must be measured.

4. Therefore it appears, that the best method to take a level, is to measure the several distances from the instrument to the back and forward station-staves; and enter them in the field-book, according to the titles of their several columns, as in the following example; and correct the heights from the table of allowances; which may be done at home, when you are about to sum up the heights.

Backwards.			Forwards.		
Distan.	Height	Corrected	Distan.	Height	Corrected
Links.	Inches	Inches	Links.	Inches	Inches
370	3,25	3,24	418	4 36	4,34
430	6,10	6,08	328	7,18	7,17
760	5,38	5,31	289	6,75	6,67
584	7,25	7,21	530	9,53	9,50
326	8,15	8,14	485	11,25	11,22
658	10,25	10,20	376	8,65	8,63
530	6,32	6,29	720	10,34	10,28
3658		46,47	31,46		57,81
3146					46,46
68,04					11,34

So that the fall in 68 chains is about 11 inches and $\frac{1}{3}$ of an inch.

Lastly, Though hitherto we have considered the level with one telescope only, the same observations may be applied to a level with a double telescope; and I would advise those who use the double telescope, at every station to turn that end of the telescope forward, which before was the contrary way.

A more general method of levelling, adapted to the surveying of roads and hilly ground, is exhibited in the following example, in which the measures are given in links.

EXAMPLE.

Plate XIII. fig. 8.

Required the bearing and distance of the place B from A, and its perpendicular ascent or descent, above or below the horizontal level of A.

Stat

Stat.	Course or Bearing.	Elev. or Depres.	Obl. Dist.	Hor. Dist.	Perpen. Aſcent or Deſc.	Dif. Lat.	De-part.
1	NE 79° 15′	D 17° 15′	738	705	218.9	131	692
2	NE 75 00	D 21 45	684	635	253.4	164	613
3	NE 50 30	E 14 00	976	947	236.1	602	730
4	S E 85 15	D 11 30	930	911	185.4	75	908
5	S E 70 00	E 19 15	620	585	204.0	200	549
			3948	3783	217.6 Desc.	622 N.	3492 E.

As Dif. Lat. 622	As S. Bear. 79° 54′
Is to radius S. 90°,	Is to Dep. 3492,
So is Dep. 3492	So is radius S. 90°
To T. Bear. 79° 54′.	To Dist. 3547.

As 100 links : 66 feet : : 217.6 links : 143.6 feet, the descent of B below the level of A.

Hence, B bears N. 79° 54′ E. from A.
Nearest horiz. dist. 3547 links.
Sum of obl. dist. 3948 links.
Sum of horiz. dist. 3783 links.
Perp. desc. 217.6 L.=143.6 F.
} Answer.

With the angular elevation or depression in the third column, and the oblique distance in the fourth (as course and distance) are found the horizontal distance in the fifth, and the perpendicular ascent or descent in the sixth, for each station (as difference of latitude and departure :) then with the bearing and horizontal distance we get the difference of latitude and departure in the two last columns.

The ascents and descents in the sixth column are distinguished by the letters E and D in the third, signifying elevation or depression: and being added separately, the difference of their sums is set at the bottom of the column with the name of the greater, and shews the perpendicular descent of B below the horizontal level of A.

In like manner the northings and southings in the seventh column are distinguished by the letters N and S in the second, &c.

* * *

Promiscuous Questions.

1. THE perambulator, or surveying wheel, is so contrived as to turn just twice in the length of a pole, or 16½ feet; what then is the diameter?

Answ. 2.626 feet.

2. Two sides of a triangle are respectively 20 and 40 perches; required the third so that the content may be just an acre?

Answ. either 23.099 or 58.876 perches.

3. I want the length of a line by which my gardener may strike out a round orangery that shall contain just half an acre of ground?

Answ. 27¾ yards.

4. What proportion does the arpent of France, which contains 100 square poles of 18 feet each, bear to the American acre, containing 160 square poles of 16.5 feet each, considering that the length of the French foot is to the American as 16 to 15?

Answ. as 512 to 605.

5. The ellipse in Grovesnor square measures 840 links the longest way, and 612 the shortest, within the rails; now the wall being 14 inches thick, it is required to find what quantity of ground it incloses, and how much it stands upon?

Answ. It incloses 4A. 16P. and stands on 1760½ square feet.

6. Required the dimensions of an elliptical acre, with the greatest and least diameters in the proportion of 3 to 2?

Answ. 17.479 by 11.653 perches.

7. The paving of a triangular court, at 18*d.* per foot, came to 100*l.* The longest of the three sides was 88 feet: what then was the sum of the other two equal sides? Answ. 106.85 feet.

8. In 110 acres of statute measure, in which the pole is 16½ feet, how many Cheshire acres, where the customary pole is 6 yards, and how many of Ireland, where the pole in use is 7 yards?

Ans. 92A. 1R. 28P. Cheshire; 67A. 3R. 25P. Irish.

9. The three sides of a triangle containing 6A. 1R. 12P. are in the ratio of the three numbers, 9, 8, 6, respectively; required the sides;

Answ. 59.029, 52.47, and 39.353.

10. In a pentangular field, beginning with the south side, and measuring round towards the east, the first or south side is 2735 links, the second 3115, the third 2370, the fourth 2925, and the fifth 2220; also the diagonal from the first angle to the third is 3800 links, and that from the third to the fifth 4010: required the area of the field?

Answ. 117A. 2R. 28P.

11. Required the dimensions of an oblong garden, containing three acres, and bounded by 104 perches of pale fence?

Answ. 40 perches by 12.

12. How many acres are contained in a square meadow, the diagonal of which is 20 perches more than either of its sides?

Answ. 4A. 2R. 11P.

13. If a man six feet high travel round the earth, how much greater will be the circumference described by the top of his head, that by his feet?

Answ. 37.69 feet.

N. B. The required difference is equal to the circumference of a circle of 6 feet radius, let the magnitude of the earth be what it may.

14. Required the dimensions of a parallelogram containing 200 acres, which is 40 perches longer than wide?

Answ. 200 perches by 160.

15. What difference is there between a lot 28 perches long by 20 broad, and two others each of half those dimensions?

Answ. 1A. 3R.

FINIS.

TABLES

OF

DIFFERENCE

OF

LATITUDE AND DEPARTURE:

CONSTRUCTED

TO EVERY QUARTER OF A DEGREE OF
THE QUADRANT,

And continued from One, to the Diſtance of One Hundred
MILES or CHAINS:—

OF

LOGARITHMS,

FROM 1 TO 10,000:—

AND OF

Artificial Sines, Tangents, and Secants.

CAREFULLY REVISED AND CORRECTED.

PHILADELPHIA:
PRINTED AND SOLD BY *JOSEPH* & *JAMES CRUKSHANK*,
NO. 87, HIGH-STREET.

1803.

Dist.	¼ Deg.		½ Deg.		¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1.00	0.00	1.00	0.01	1.00	0.01	1
2	2.00	0.01	2.00	0.02	2.00	0.03	2
3	3.00	0.01	3.00	0.03	3.00	0.04	3
4	4.00	0.02	4.00	0.03	4.00	0.05	4
5	5.00	0.02	5.00	0.04	5.00	0.07	5
6	6.00	0.03	6.00	0.05	6.00	0.08	6
7	7.00	0.03	7.00	0.06	7.00	0.09	7
8	8.00	0.03	8.00	0.07	8.00	0.10	8
9	9.00	0.04	9.00	0.08	9.00	0.12	9
10	10.00	0.04	10.00	0.09	10.00	0.13	10
11	11.00	0.05	11.00	0.10	11.00	0.14	11
12	12.00	0.05	12.00	0.10	12.00	0.16	12
13	13.00	0.06	13.00	0.11	13.00	0.17	13
14	14.00	0.06	14.00	0.12	14.00	0.18	14
15	15.00	0.07	15.00	0.13	15.00	0.20	15
16	16.00	0.07	16.00	0.14	16.00	0.21	16
17	17.00	0.07	17.00	0,15	17.00	0.22	17
18	18.00	0.08	18.00	0.16	18.00	0.24	18
19	19.00	0.08	19.00	0.17	19.00	0.25	19
20	20.00	0.09	20.00	0.17	20.00	0.26	20
21	21.00	0.09	21.00	0.18	21.00	0.27	21
22	22.00	0.10	22.00	0.19	22.00	0.29	22
23	23.00	0.10	23.00	0.20	23.00	0.30	23
24	24.00	0.10	24.00	0.21	24.00	0.31	24
25	25.00	0.11	25.00	0.22	25.00	0.33	25
26	26.00	0.11	26.00	0.23	26.00	0.34	26
27	27.00	0.12	27.00	0.24	27.00	0.35	27
28	28.00	0.12	28.00	0.24	28.00	0.37	28
29	29.00	0.13	29.00	0.25	29.00	0.38	29
30	30.00	0.13	30.00	0.26	30.00	0.39	30
31	31.00	0.14	31.00	0.27	31.00	0.41	31
32	32.00	0.14	32.00	0.28	32.00	0.42	32
33	33.00	0.14	33.00	0.29	33.00	0.43	33
34	34.00	0.15	34.00	0.30	34.00	0.45	34
35	35.00	0.15	35.00	0.31	35.00	0.46	35
36	36.00	0.16	36.00	0.31	36.00	0.47	36
37	37.00	0.16	37.00	0.32	37.00	0.48	37
38	38.00	0.17	38.00	0.33	38.00	0.50	38
39	39.00	0.17	39.00	0.34	39.00	0.51	39
40	40.00	0.17	40.00	0.35	40.00	0.52	40
41	41.00	0.18	41.00	0.36	41.00	0.54	41
42	42.00	0.18	42.00	0.37	42.00	0.55	42
43	43.00	0.19	43.00	0.38	43.00	0.56	43
44	44.00	0.19	44.00	0.38	44.00	0.58	44
45	45.00	0.20	45.00	0.39	45.00	0.59	45
46	46.00	0.20	46.00	0.40	46.00	0.60	46
47	47.00	0.21	47.00	0.41	47.00	0.62	47
48	48.00	0.21	48.00	0.42	48.00	0.63	48
49	49.00	0.21	49.00	0.43	49.00	0.64	49
50	50.00	0.22	50.00	0.44	50.00	0.65	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	89¾ Deg.		89½ Deg.		89¼ Deg.		

Dist.	¼ Deg.		½ Deg.		¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	51.00	0.22	51.00	0.45	51.00	0.67	51
52	52.00	0.23	52.00	0.45	52.00	0.68	52
53	53.00	0.23	53.00	0.46	53.00	0.69	53
54	54.00	0.24	54.00	0.47	54.00	0.71	54
55	55.00	0.24	55.00	0.48	55.00	0.72	55
56	56.00	0.24	56.00	0.49	56.00	0.73	56
57	57.00	0.25	57.00	0.50	57.00	0.75	57
58	58.00	0.25	58.00	0.51	57.99	0.76	58
59	59.00	0.26	59.00	0.51	58.99	0.77	59
60	60.00	0.26	60.00	0.52	59.99	0.79	60
61	61.00	0.27	61.00	0.53	60.99	0.80	61
62	62.00	0.27	62.00	0.54	61.99	0.81	62
63	63.00	0.27	63.00	0.55	62.99	0.82	63
64	64.00	0.28	64.00	0.56	63.99	0.84	64
65	65.00	0.28	65.00	0.57	64.99	0.85	65
66	66.00	0.29	66.00	0.58	65.99	0.86	66
67	67.00	0.29	67.00	0.58	66.99	0.88	67
68	68.00	0.30	68.00	0.59	67.99	0.89	68
69	69.00	0.30	69.00	0.60	68.99	0.90	69
70	70.00	0.31	70.00	0.61	69.99	0.92	70
71	71.00	0.31	71.00	0.62	70.99	0.93	71
72	72.00	0.31	72.00	0.63	71.99	0.94	72
73	73.00	0.32	73.00	0.64	72.99	0.96	73
74	74.00	0.32	74.00	0.65	73.99	0.97	74
75	75.00	0.33	75.00	0.65	74.99	0.98	75
76	76.00	0.33	76.00	0.66	75.99	0.99	76
77	77.00	0.34	77.00	0.67	76.99	1.01	77
78	78.00	0.34	78.00	0.68	77.99	1.02	78
79	79.00	0.34	79.00	0.69	78.99	1.03	79
80	80.00	0.35	80.00	0.70	79.99	1.05	80
81	81.00	0.35	81.00	0.71	80.99	1.06	81
82	82.00	0.36	82.00	0.72	81.99	1.07	82
83	83.00	0.36	83.00	0.72	82.99	1.09	83
84	84.00	0.37	84.00	0.73	83.99	1.10	84
85	85.00	0.37	85.00	0.74	84.99	1.11	85
86	86.00	0.38	86.00	0.75	85.99	1.13	86
87	87.00	0.38	87.00	0.76	86.99	1.14	87
88	88.00	0.38	88.00	0.77	87.99	1.15	88
89	89.00	0.39	89.00	0.78	88.99	1.16	89
90	90.00	0.39	90.00	0.79	89.99	1.18	90
91	91.00	0.40	91.00	0.79	90.99	1.19	91
92	92.00	0.40	92.00	0.80	91.99	1.20	92
93	93.00	0.41	93.00	0.81	92.99	1.22	93
94	94.00	0.41	94.00	0.82	93.99	1.23	94
95	95.00	0.41	95.00	0.83	94.99	1.24	95
96	96.00	0.42	96.00	0.84	95.99	1.26	96
97	97.00	0.42	97.00	0.85	96.99	1.27	97
98	98.00	0.43	98.00	0.86	97.99	1.28	98
99	99.00	0.43	99.00	0.86	98.99	1.30	99
100	100.0	0.44	100.0	0.87	99.99	1.31	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	89¾ Deg.		89½ Deg.		89¼ Deg.		

Dist.	1 Deg.		1¼ Deg.		1½ Deg.		1¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1.00	0.02	1.00	0.02	1.00	0.03	1.00	0.03	1
2	2.00	0.03	2.00	0.04	2.00	0.05	2.00	0.06	2
3	3.00	0.05	3.00	0.07	3.00	0.08	3.00	0.09	3
4	4.00	0.07	4.00	0.09	4.00	0.10	4.00	0.12	4
5	5.00	0.09	5.00	0.11	5.00	0.13	5.00	0.15	5
6	6.00	0.10	6.00	0.13	6.00	0.16	6.00	0.18	6
7	7.00	0.12	7.00	0.15	7.00	0.18	7.00	0.21	7
8	8.00	0.14	8.00	0.17	8.00	0.21	8.00	0.25	8
9	9.00	0.16	9.00	0.20	9.00	0.24	9.00	0.28	9
10	10.00	0.17	10.00	0.22	10.00	0.26	10.00	0.31	10
11	11.00	0.19	11.00	0.24	11.00	0.28	10.99	0.34	11
12	12.00	0.21	12.00	0.26	12.00	0.31	11.99	0.37	12
13	13.00	0.23	13.00	0.28	13.00	0.34	12.99	0.40	13
14	14.00	0.24	14.00	0.31	14.00	0.37	13.99	0.43	14
15	15.00	0.26	15.00	0.33	14.99	0.39	14.99	0.46	15
16	16.00	0.28	16.00	0.35	15.99	0.42	15.99	0.49	16
17	17.00	0.30	17.00	0.37	16.99	0.45	16.99	0.52	17
18	18.00	0.31	18.00	0.39	17.99	0.47	17.99	0.55	18
19	19.00	0.33	19.00	0.41	18.99	0.50	18.99	0.58	19
20	20.00	0.35	20.00	0.44	19.99	0.52	19.99	0.61	20
21	21.00	0.37	21.00	0.46	20.99	0.55	20.99	0.64	21
22	22.00	0.38	21.99	0.48	21.99	0.58	21.99	0.67	22
23	23.00	0.40	22.99	0.50	22.99	0.60	22.99	0.70	23
24	24.00	0.42	23.99	0.52	23.99	0.63	23.99	0.73	24
25	25.00	0.44	24.99	0.55	24.99	0.65	24.99	0.76	25
26	26.00	0.45	25.99	0.57	25.99	0.68	25.99	0.79	26
27	27.00	0.47	26.99	0.59	26.99	0.71	26.99	0.83	27
28	28.00	0.49	27.99	0.61	27.99	0.73	27.99	0.86	28
29	29.00	0.51	28.99	0.63	28.99	0.76	28.99	0.89	29
30	30.00	0.52	29.99	0.65	29.99	0.79	29.99	0.92	30
31	31.00	0.54	30.99	0.68	30.99	0.81	30.99	0.95	31
32	32.00	0.56	31.99	0.70	31.99	0.84	31.99	0.98	32
33	32.99	0.58	32.99	0.72	32.99	0.86	32.98	1.01	33
34	33.99	0.59	33.99	0.74	33.99	0.89	33.98	1.04	34
35	34.99	0.61	34.99	0.76	34.99	0.92	34.98	1.07	35
36	35.99	0.63	35.99	0.79	35.99	0.94	35.98	1.10	36
37	36.99	0.65	36.99	0.81	36.99	0.97	36.98	1.13	37
38	37.99	0.66	37.99	0.83	37.99	0.99	37.98	1.16	38
39	38.99	0.68	38.99	0.85	38.99	1.02	38.98	1.19	39
40	39.99	0.70	39.99	0.87	39.99	1.05	39.98	1.22	40
41	40.99	0.72	40.99	0.89	40.99	1.07	40.98	1.25	41
42	41.99	0.73	41.99	0.92	41.99	1.10	41.98	1.28	42
43	42.99	0.75	42.99	0.94	42.99	1.13	42.98	1.31	43
44	43.99	0.77	43.99	0.96	43.99	1.15	43.98	1.34	44
45	44.99	0.79	44.99	0.98	44.99	1.18	44.98	1.37	45
46	45.99	0.80	45.99	1.00	45.99	1.20	45.98	1.40	46
47	46.99	0.82	46.99	1.03	46.99	1.23	46.98	1.44	47
48	47.99	0.84	47.99	1.05	47.98	1.26	47.98	1.47	48
49	48.99	0.86	48.99	1.07	48.98	1.28	48.98	1.50	49
50	49.99	0.87	49.99	1.09	49.98	1.31	49.98	1.53	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	89 Deg.		88¾ Deg.		88½ Deg		88¼ Deg.		

Dist.	1 Deg.		1¼ Deg.		1½ Deg.		1¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.99	0.89	50.99	1.11	50.98	1.34	50.98	1.56	51
52	51.99	0.91	51.99	1.13	51.98	1.36	51.98	1.59	52
53	52.99	0.92	52.99	1.16	52.98	1.39	52.98	1.62	53
54	53.99	0.94	53.99	1.18	53.98	1.41	53.97	1.65	54
55	54.99	0.96	54.99	1.20	54.98	1.44	54.97	1.68	55
56	55.99	0.98	55.99	1.22	55.98	1.47	55.97	1.71	56
57	56.99	0.99	56.99	1.24	56.98	1.49	56.97	1.74	57
58	57.99	1.01	57.99	1.27	57.98	1.52	57.97	1.77	58
59	58.99	1.03	58.99	1.29	58.98	1.54	58.97	1.80	59
60	59.99	1.05	59.99	1.31	59.98	1.57	59.97	1.83	60
61	60.99	1.06	60.99	1.33	60.98	1.60	60.97	1.86	61
62	61.99	1.08	61.99	1.35	61.98	1.62	61.97	1.89	62
63	62.99	1.10	62.99	1.37	62.98	1.65	62.97	1.92	63
64	63.99	1.12	63.98	1.40	63.98	1.68	63.97	1.95	64
65	64.99	1.13	64.98	1.42	64.98	1.70	64.97	1.99	65
66	65.99	1.15	65.98	1.44	65.98	1.73	65.97	2.02	66
67	66.99	1.17	66.98	1.46	66.98	1.75	66.97	2.05	67
68	67.99	1.19	67.98	1.48	67.98	1.78	67.97	2.08	68
69	68.99	1.20	68.98	1.51	68.98	1.81	68.97	2.11	69
70	69.99	1.22	69.98	1.53	69.98	1.83	69.97	2.14	70
71	70.99	1.24	70.98	1.55	70.98	1.86	70.97	2.17	71
72	71.99	1.26	71.98	1.57	71.98	1.88	71.97	2.20	72
73	72.99	1.27	72.98	1.59	72.97	1.91	72.97	2.23	73
74	73.99	1.29	73.98	1.61	73.97	1.94	73.97	2.26	74
75	74.99	1.31	74.98	1.64	74.97	1.96	74.97	2.29	75
76	75.99	1.33	75.98	1.66	75.97	1.99	75.96	2.32	76
77	76.99	1.34	76.98	1.68	76.97	2.02	76.96	2.35	77
78	77.99	1.36	77.98	1.70	77.97	2.04	77.96	2.38	78
79	78.99	1.38	78.98	1.72	78.97	2.07	78.96	2.41	79
80	79.99	1.40	79.98	1.75	79.97	2.09	79.96	2.44	80
81	80.99	1.41	80.98	1.77	80.97	2.12	80.96	2.47	81
82	81.99	1.43	81.98	1.79	81.97	2.15	81.96	2.50	82
83	82.99	1.45	82.98	1.81	82.97	2.17	82.96	2.53	83
84	83.99	1.47	83.98	1.83	83.97	2.20	83.96	2.57	84
85	84.99	1.48	84.98	1.85	84.97	2.23	84.96	2.60	85
86	85.99	1.50	85.98	1.88	85.97	2.25	85.96	2.63	86
87	86.99	1.52	86.98	1.90	86.97	2.28	86 96	2.66	87
88	87.99	1.54	87.98	1.92	87.97	2.30	87.96	2.69	88
89	88.99	1.55	88.98	1.94	88.97	2.33	88.96	2.72	89
90	89.99	1.57	89.98	1.96	89.97	2.36	89.96	2.75	90
91	90.99	1.59	90.98	1.99	90.97	2.38	90.96	2.78	91
92	91.99	1.61	91.98	2.01	91.97	2.41	91.96	2.81	92
93	92.99	1.62	92.98	2.03	92.97	2.43	92.96	2.84	93
94	93.99	1.64	93.98	2.05	93.97	2.46	93.96	2.87	94
95	94.99	1.66	94.98	2.07	94.97	2.49	94.96	2.90	95
96	95.99	1.68	95.98	2.09	95.97	2.51	95.96	2.94	96
97	96.99	1.69	96.98	2.12	96.97	2.54	96.95	2.96	97
98	97.99	1.71	97.98	2.14	97.97	2.57	97.95	2.99	98
99	98.98	1.73	98.98	2.16	98.97	2.59	98.95	3.02	99
100	99.98	1.75	99.98	2.18	99.97	2.62	99.95	3.05	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	89 Deg.		88¾ Deg.		88½ Deg.		88¼ Deg.		

Dist.	2 Deg.		2¼ Deg.		2½ Deg.		2¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1.00	0.03	1.00	0.04	1.00	0.04	1.00	0.05	1
2	2.00	0.07	2.00	0.08	2.00	0.09	2.00	0.10	2
3	3.00	0.10	3.00	0.12	3.00	0.13	3.00	0.14	3
4	4.00	0.14	4.00	0.16	4.00	0.17	4.00	0.19	4
5	5.00	0.17	5.00	0.20	5.00	0.22	4.99	0.24	5
6	6.00	0.21	6.00	0.24	5.99	0.26	5.99	0.29	6
7	7.00	0.24	6.99	0.27	6.99	0.31	6.99	0.34	7
8	7.99	0.28	7.99	0.31	7.99	0.35	7.99	0.38	8
9	8.99	0.31	8.99	0.35	8.99	0.39	8.99	0.43	9
10	9.99	0.35	9.99	0.39	9.99	0.44	9.99	0.48	10
11	10.99	0.38	10.99	0.43	10.99	0.48	10.99	0.53	11
12	11.99	0.42	11.99	0.47	11.99	0.52	11.99	0.58	12
13	12.99	0.45	12.99	0.51	12.99	0.57	12.99	0.62	13
14	13.99	0.49	13.99	0.55	13.99	0.61	13.98	0.67	14
15	14.99	0.52	14.99	0.59	14.99	0.65	14.98	0.72	15
16	15.99	0.56	15.99	0.63	15.99	0.70	15.98	0.77	16
17	16.99	0.59	16.99	0.67	16.98	0.74	16.98	0.82	17
18	17.99	0.63	17.99	0.71	17.98	0.79	17.98	0.86	18
19	18.99	0.66	18.99	0.75	18.98	0.83	18.98	0.91	19
20	19.99	0.70	19.98	0.79	19.98	0.87	19.98	0.96	20
21	20.99	0.73	20.98	0.82	20.98	0.92	20.98	1.01	21
22	21.99	0.77	21.98	0.86	21.98	0.96	21.97	1.06	22
23	22.99	0.80	22.98	0.90	22.98	1.00	22.97	1.10	23
24	23.99	0.84	23.98	0.94	23.98	1.05	23.97	1.15	24
25	24.98	0.87	24.98	0.98	24.98	1.09	24.97	1.20	25
26	25.98	0.91	25.98	1.02	25.98	1.13	25.97	1.25	26
27	26.98	0.94	26.98	1.06	26.97	1.18	26.97	1.30	27
28	27.98	0.98	27.98	1.10	27.97	1.22	27.97	1.34	28
29	28.98	1.01	28.98	1.14	28.97	1.26	28.97	1.39	29
30	29.98	1.05	29.98	1.18	29.97	1.31	29.97	1.44	30
31	30.98	1.08	30.98	1.22	30.97	1.35	30.96	1.49	31
32	31.98	1.12	31.98	1.26	31.97	1.40	31.96	1.54	32
33	32.98	1.15	32.97	1.30	32.97	1.44	32.96	1.58	33
34	33.98	1.19	33.97	1.33	33.97	1.48	33.96	1.63	34
35	34.98	1.22	34.97	1.37	34.97	1.53	34.96	1.68	35
36	35.98	1.26	35.97	1.41	35.97	1.57	35.96	1.73	36
37	36.98	1.29	36.97	1.45	36.96	1.61	36.96	1.78	37
38	37.98	1.33	37.97	1.49	37.96	1.66	37.96	1.82	38
39	38.98	1.36	38.97	1.53	38.96	1.70	38.96	1.87	39
40	39.98	1.40	39.97	1.57	39.96	1.75	39.95	1.92	40
41	40.98	1.43	40.97	1.61	40.96	1.77	40.95	1.97	41
42	41.97	1.47	41.97	1.65	41.96	1.83	41.95	2.02	42
43	42.97	1.50	42.97	1.69	42.96	1.88	42.95	2.06	43
44	43.97	1.54	43.97	1.73	43.96	1.92	43.95	2.11	44
45	44.97	1.57	44.97	1.77	44.96	1.96	44.95	2.16	45
46	45.97	1.61	45.96	1.81	45.96	2.01	45.95	2.21	46
47	46.97	1.64	46.96	1.85	46.96	2.05	46.95	2.25	47
48	47.97	1.68	47.96	1.88	47.95	2.09	47.95	2.30	48
49	48.97	1.71	48.96	1.92	48.95	2.14	48.94	2.35	49
50	49.97	1.74	49.96	1.96	49.95	2.18	49.94	2.40	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	88 Deg.		87¾ Deg.		87½ Deg.		87¼ Deg.		

Dist.	2 Deg.		2¼ Deg.		2½ Deg.		2¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.97	1.78	50.96	2.00	50.95	2.22	50.94	2.45	51
52	51.97	1.81	51.96	2.04	51.95	2.27	51.94	2.50	52
53	52.97	1.85	52.96	2.08	52.95	2.31	52.94	2.54	53
54	53.97	1.88	53.96	2.12	53.95	2.36	53.94	2.59	54
55	54.97	1.92	54.96	2.16	54.95	2.40	54.94	2.64	55
56	55.97	1.95	55.96	2.20	55.95	2.44	55.94	2.69	56
57	56.97	1.99	56.96	2.24	56.95	2.49	56.93	2.73	57
58	57.96	2.02	57.96	2.28	57.94	2.53	57.93	2.78	58
59	58.96	2.06	58.95	2.32	58.94	2.57	58.93	2.83	59
60	59 96	2.09	59.95	2.36	59.94	2.62	59.93	2.88	60
61	60.96	2.13	60.95	2.39	60.94	2.66	60.93	2.93	61
62	61.96	2.16	61.95	2.43	61.94	2.70	61.93	2.97	62
63	62.95	2.20	62.95	2.47	62.94	2.75	62.93	3.02	63
64	63.96	2.23	63.95	2.51	63.94	2.79	63.93	3.07	64
65	64.96	2.27	64.95	2.55	64.94	2.84	64.93	3.12	65
66	65.96	2.30	65.95	2.59	65.94	2.88	65.92	3.17	66
67	66.96	2.34	66.95	2.63	66.94	2.92	66.92	3.21	67
68	67.96	2.37	67.95	2.67	67.94	2.97	67.92	3.26	68
69	68.96	2.41	68.95	2.71	68.93	3.01	68.92	3.31	69
70	69.96	2.44	69.95	2.75	69.93	3.05	69.92	3.36	70
71	70.96	2.48	70.95	2.79	70.93	3.10	70.92	3.41	71
72	71.96	2.51	71.94	2.83	71.93	3.14	71.92	3.45	72
73	72.96	2.55	72.94	2.87	72.93	3.18	72.92	3.50	73
74	73.95	2.58	73.94	2.91	73.93	3.23	73.91	3.55	74
75	74.95	2.62	74.94	2.94	74.93	3.27	74.91	3.60	75
76	75.95	2.65	75.94	2.98	75.93	3.31	75.91	3.65	76
77	76.95	2.69	76.94	3.02	76.93	3.36	76.91	3.70	77
78	77.95	2.72	77.94	3.06	77.93	3.40	77.91	3.74	78
79	78.95	2.76	78.94	3.10	78.92	3.45	78.91	3.79	79
80	79.95	2.79	79.94	3.14	79.92	3.49	79.91	3.84	80
81	80.95	2.83	80.94	3.18	80.92	3.53	80.91	3.89	81
82	81.95	2.86	81.94	3.22	81.92	3.58	81.91	3.93	82
83	82.95	2.90	82.94	3.26	82.92	3.62	82.90	3.98	83
84	83.95	2.93	83.94	3.30	83.92	3.66	83.90	4.03	84
85	84.95	2.97	84.93	3.34	84.92	3.71	84.90	4.08	85
86	85.95	3.00	85.93	3.38	85.92	3.75	85.90	4.13	86
87	86.95	3.04	86.93	3.42	86.92	3.79	86.90	4.17	87
88	87.95	3.07	87.93	3.45	87.92	3.84	87.90	4.22	88
89	88.95	3.11	88.93	3.49	88.92	3.88	88.90	4.27	89
90	89.95	3.14	89.93	3.53	89.91	3.93	89.90	4.32	90
91	90.95	3.18	90.93	3.57	90.91	3.97	90.90	4.37	91
92	91.94	3.21	91.93	3.61	91.91	4.01	91.89	4.41	92
93	92.94	3.25	92.93	3.65	92.91	4.06	92.89	4.46	93
94	93.94	3.28	93.93	3.69	93.91	4.10	93.89	4.51	94
95	94.94	3.32	94.93	3.73	94.91	4.14	94.89	4.56	95
96	95.94	3.35	95.93	3.77	95.91	4.19	95.89	4.61	96
97	96.94	3.39	96.93	3.81	96.91	4.23	96.89	4.65	97
98	97.94	3.42	97.92	3.85	97.91	4.27	97.89	4.70	98
99	98.94	3.46	98.92	3.89	98.91	4.32	98.89	4.75	99
100	99.94	3.49	99.92	3.93	99.91	4.36	99.88	4.80	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	88 Deg.		87¾ Deg.		87½ Deg.		87¼ Deg		Dist.

Dist.	3 Deg.		3¼ Deg.		3½ Deg.		3¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1,00	0,05	1,00	0,06	1,00	0,06	1,00	0,06	1
2	2,00	0,10	2,00	0,11	2,00	0,12	2,00	0,13	2
3	3,00	0,16	3,00	0,17	2,99	0,18	2,99	0,20	3
4	3,99	0,21	3,99	0,23	3,99	0,24	3,99	0,26	4
5	4,99	0,26	4,99	0,28	4,99	0,31	4,99	0,33	5
6	5,99	0,31	5,99	0,34	5,99	0,37	5,99	0,39	6
7	6,99	0,37	6,99	0,40	6,99	0,43	6,99	0,46	7
8	7,99	0,42	7,99	0,45	7,99	0,49	7,98	0,52	8
9	8,99	0,47	8,99	0,51	8,98	0,55	8,98	0,59	9
10	9,99	0,52	9,98	0,57	9,98	0,61	9,98	0,65	10
11	10,98	0,58	10,98	0,62	10,98	0,67	10,98	0,72	11
12	11,98	0,63	11,98	0,68	11,98	0,73	11,97	0,78	12
13	12,98	0,68	12,98	0,73	12,98	0,79	12,97	0,85	13
14	13,98	0,73	13,98	0,79	13,97	0,85	13,97	0,92	14
15	14,98	0,79	14,98	0,85	14,97	0,92	14,97	0,98	15
16	15,98	0,84	15,97	0,91	15,97	0,98	15,97	1,05	16
17	16,98	0,89	16,97	0,96	16,97	1,04	16,96	1,11	17
18	17,98	0,94	17,97	1,02	17,97	1,10	17,96	1,18	18
19	18,98	0,99	18,97	1,08	18,96	1,16	18,96	1,24	19
20	19,97	1,05	19,97	1,13	19,96	1,22	19,96	1,31	20
21	20,97	1,10	20,97	1,19	20,96	1.28	20,96	1,37	21
22	21,97	1,15	21,96	1,25	21,96	1.34	21,95	1,44	22
23	22,97	1,20	22,96	1,30	22,96	1.40	22,95	1,50	23
24	23,97	1,26	23,96	1,36	23,96	1.47	23,95	1,57	24
25	24,97	1,31	24,96	1,42	24,95	1.53	24,95	1,64	25
26	25,96	1,36	25,96	1,47	25,95	1.59	25,94	1,70	26
27	26,96	1,41	26,96	1,53	26,95	1.65	26,94	1,77	27
28	27,96	1,47	27,95	1,59	27,95	1.71	27.94	1,83	28
29	28,96	1,52	28,95	1,64	28,95	1.77	28,94	1,90	29
30	29,96	1.57	29,95	1.70	29,94	1.83	29,94	1,96	30
31	30,96	1,62	30,95	1,76	30,94	1,89	30,93	2,03	31
32	31,96	1,67	31,95	1,81	31,94	1,95	31,93	2,09	32
33	32,95	1,73	32,95	1,87	32,94	2,01	32,93	2,16	33
34	33,95	1,78	33,95	1,93	33,94	2,08	33,93	2,22	34
35	34,95	1,83	34,94	1,98	34,93	2,14	34,92	2,29	35
36	35,95	1,88	35.94	2,04	35,93	2,20	35,92	2,35	36
37	36,95	1,94	36,94	2,10	36,93	2,26	36,92	2,42	37
38	37,95	1,99	37,94	2,15	37,93	2,32	37,92	2,49	38
39	38,95	2,04	38,94	2,21	38,93	2,38	38,92	2,55	39
40	39,95	2,09	39,94	2,27	39,93	2,44	39,91	2,62	40
41	40,94	2,15	40,93	2,32	40,92	2,50	40,91	2,68	41
42	41,94	2,20	41,93	2,38	41,92	2,56	41,91	2,75	42
43	42,94	2,25	42,93	2,44	42,92	2,63	42,91	2,81	43
44	43,94	2,30	43,93	2,49	43,92	2,69	43,91	2,88	44
45	44,94	2,36	44.93	2,55	44,92	2,75	44,90	2,94	45
46	45,94	2,41	45,93	2,61	45,91	2,81	45,90	3,01	46
47	46,94	2,46	46,92	2,66	46,91	2,87	46,90	3,07	47
48	47,93	2,51	47,92	2,72	47,91	2,93	47,90	3,14	48
49	48,93	2,56	48,92	2,78	48,91	2,99	48,90	3,20	49
50	49,93	2,62	49,92	2,83	49,91	3,05	49,89	3,27	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	87 Deg.		86¾ Deg		86½ Deg.		86¼ Deg.		Dist.

Diſt.	3 Deg.		3¼ Deg.		3½ Deg.		3¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50,93	2,67	50,92	2,89	50,90	3,11	50,89	3,34	51
52	51,93	2,72	51,92	2,95	51,90	3,17	51,89	3,40	52
53	52,93	2,77	52,91	3,00	52,90	3,24	52,89	3,47	53
54	53,93	2,83	53,91	3,06	53,90	3,30	53,88	3,53	54
55	54,92	2,88	54,91	3,12	54,90	3,36	54,88	3,60	55
56	55,92	2,93	55,91	3,17	55.90	3,42	55,88	3,66	56
57	56,92	2,98	56,91	3,23	56,89	3,48	56,88	3,73	57
58	57,92	3,04	57,91	3,29	57,89	3,54	57,88	3,79	58
59	58,92	3,09	58,91	3,34	58,89	3,60	58,87	3,86	59
60	59,92	3,14	59,90	3,40	59,89	3,66	59,87	3,92	60
61	60,92	3,19	60,90	3,46	60,89	3,72	60,87	3,99	61
62	61,92	3,24	61,90	3,51	61,88	3,79	61,87	4,05	62
63	62,91	3,30	62,90	3,57	62,88	3,85	62,87	4,12	63
64	63,91	3,35	63,90	3,63	63,88	3,91	63,86	4,19	64
65	64,91	3,40	64,90	3,69	64,88	3,97	64,86	4,25	65
66	65,91	3,45	65,89	3,74	65,88	4,03	65,86	4,32	66
67	66,91	3,51	66,89	3,80	66,88	4,09	66,86	4,38	67
68	67,91	3,56	67,89	3,86	67,87	4,15	67,85	4,45	68
69	68,91	3,61	68,89	3,91	68,87	4,21	68,85	4,51	69
70	69,91	3,66	69,89	3,97	69,87	4,27	69,85	4,58	70
71	70,90	3,72	70,89	4,03	70,87	4,33	70,85	4,64	71
72	71,90	3,77	71,88	4,08	71,87	4,40	71,85	4,71	72
73	72,90	3,82	72,88	4,14	72,86	4,46	72.84	4,77	73
74	73,90	3,87	73,88	4,20	73,86	4,52	73,84	4,84	74
75	74,90	3,93	74,88	4,25	74,86	4,58	74,84	4,91	75
76	75,90	3,98	75,88	4,31	75,86	4,64	75,84	4,97	76
77	76,89	4,03	76,88	4,37	76,86	4,70	76,84	5,04	77
78	77,89	4,08	77,87	4,42	77,85	4,76	77,83	5,10	78
79	78,89	4,13	78,87	4,48	78,85	4,82	78,83	5,17	79
80	79,89	4,19	79,87	4,54	79,85	4,88	79,83	5,23	80
81	80,89	4,24	80,87	4,59	80,85	4,94	80,83	5,30	81
82	81,89	4,29	81,87	4,65	81,85	5,01	81,82	5,36	82
83	82,89	4,34	82,87	4,71	82,85	5,07	82,82	5,43	83
84	83,89	4,40	83,86	4,76	83,84	5,13	83,82	5,49	84
85	84,88	4,45	84,86	4,82	84,84	5,19	84,82	5,56	85
86	85,88	4,50	85,86	4,88	85,84	5,25	85,82	5,62	86
87	86.88	4,55	86,86	4,93	86,84	5,31	86,81	5,69	87
88	87,88	4,61	87,86	4,99	87,84	5,37	87,81	5,76	88
89	88,88	4,66	88,86	5,05	88,83	5,43	88,81	5,82	89
90	89,88	4,71	89,86	5,10	89,83	5,49	89,81	5,89	90
91	90,88	4,76	90,85	5,16	90,83	5,56	90,81	5,95	91
92	91,87	4,81	91,85	5,22	91,83	5,62	91,80	6,02	92
93	92,87	4,87	92,85	5,27	92,83	5,68	92,80	6,08	93
94	93,87	4,92	93,85	5,33	93,82	5,74	93,80	6,15	94
95	94,87	4,97	94,85	5,39	94,82	5,80	94,80	6,21	95
96	95,87	5,02	95,85	5,44	95,82	5,86	95,79	6,28	96
97	96,87	5,08	96,84	5,50	96,82	5,92	96,79	6,34	97
98	97,87	5,13	97,84	5,56	97,82	5,98	97,79	6,41	98
99	98,86	5,18	98,84	5,61	98,82	6,04	98.79	6,47	99
100	99,86	5,23	99,84	5,67	99,81	6,10	99,79	6,54	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	87 Deg.		86¾ Deg.		86½ Deg.		86¼ Deg.		

Diſt.	4 Deg.		4¼ Deg.		4½ Deg.		4¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1.00	0.07	1.00	0.07	1.00	0.08	1.00	0.08	1
2	2.00	0.14	1.99	0.15	1.99	0.16	1.99	0.17	2
3	2.99	0.21	2.99	0.22	2.99	0.24	2.99	0.25	3
4	3.99	0.28	3.99	0.30	3.99	0.31	3.98	0.33	4
5	4.99	0.35	4.99	0.37	4.98	0.39	4.98	0.41	5
6	5.99	0.42	5.98	0.44	5.98	0.47	5.98	0.50	6
7	6.98	0.49	6.98	0.52	6.98	0.55	6.97	0.58	7
8	7.98	0.56	7.98	0.59	7.98	0.63	7.97	0.66	8
9	8.98	0.63	8.98	0.67	8.97	0.71	8.97	0.75	9
10	9.98	0.70	9.97	0.74	9.97	0.78	9.97	0.83	10
11	10.97	0.77	10.97	0.82	10.97	0.86	10.96	0.91	11
12	11.97	0.84	11.97	0.89	11.96	0.94	11.96	0.99	12
13	12.97	0.91	12.96	0.96	12.96	1.02	12.96	1.08	13
14	13.97	0.98	13.96	1.04	13.96	1.10	13.95	1.16	14
15	14.96	1.05	14.96	1.11	14.95	1.18	14.95	1.24	15
16	15.96	1.12	15.96	1.19	15.95	1.26	15.95	1.32	16
17	16.96	1.19	16.95	1.26	16.95	1.33	16.94	1.41	17
18	17.96	1.26	17.95	1.33	17.94	1.41	17.94	1.49	18
19	18.95	1.33	18.95	1.40	18.94	1.49	18.93	1.57	19
20	19.95	1.40	19.95	1.48	19.94	1.57	19.93	1.66	20
21	20.95	1.46	20.94	1.56	20.94	1.65	20.93	1.74	21
22	21.95	1.53	21.94	1.63	21.93	1.73	21.92	1.82	22
23	22.94	1.60	22.94	1.70	22.93	1.80	22.92	1.90	23
24	23.94	1.67	23.93	1.78	23.93	1.88	23.92	1.99	24
25	24.94	1.74	24.93	1.85	24.92	1.96	24.91	2.07	25
26	25.94	1.81	25.93	1.93	25.92	2.04	25.91	2.15	26
27	26.93	1.88	26.93	2.00	26.92	2.12	26.91	2.24	27
28	27.93	1.95	27.92	2.08	27.91	2.20	27.90	2.32	28
29	28.93	2.02	28.92	2.15	28.91	2.28	28.90	2.40	29
30	29.93	2.09	29.92	2.22	29.91	2.35	29.90	2.48	30
31	30.92	2.16	30.91	2.30	30.90	2.43	30.89	2.57	31
32	31.92	2.23	31.91	2.37	31.90	2.51	31.89	2.65	32
33	32.92	2.30	32.91	2.45	32.90	2.59	32.89	2.73	33
34	33.92	2.37	33.91	2.52	33.90	2.67	33.88	2.82	34
35	34.91	2.44	34.90	2.59	34.89	2.75	34.88	2.90	35
36	35.91	2.51	35.90	2.67	35.89	2.82	35.88	2.98	36
37	36.91	2.58	36.90	2.74	36.89	2.90	36.87	3.06	37
38	37.91	2.65	37.90	2.82	37.88	2.98	37.87	3.15	38
39	38.90	2.72	38.89	2.89	38.88	3.06	38.87	3.23	39
40	39.90	2.79	39.89	2.96	39.88	3.14	39.86	3.31	40
41	40.90	2.86	40.89	3.04	40.87	3.22	40.86	3.40	41
42	41.90	2.93	41.88	3.11	41.87	3.30	41.86	3.48	42
43	42.90	3.00	42.88	3.19	42.87	3.37	42.85	3.56	43
44	43.89	3.07	43.88	3.26	43.86	3.45	43.85	3.64	44
45	44.89	3.14	44.88	3.33	44.86	3.53	44.85	3.73	45
46	45.89	3.21	45.87	3.41	45.86	3.61	45.84	3.81	46
47	46.89	3.28	46.87	3.48	46.86	3.69	46.84	3.89	47
48	47.88	3.35	47.87	3.56	47.85	3.77	47.84	3.97	48
49	48.88	3.42	48.87	3.63	48.85	3.84	48.83	4.06	49
50	49.88	3.49	49.86	3.71	49.85	3.92	49.83	4.14	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	86 Deg.		85¾ Deg.		85½ Deg.		85¼ Deg.		

Dist.	4 Deg.		4¼ Deg.		4½ Deg.		4¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.88	3.56	50.86	3.78	50.84	4.00	50.82	4.22	51
52	51.87	3.63	51.86	3.85	51.84	4.08	51.82	4.31	52
53	52.87	3.70	52.85	3.93	52.84	4.16	52.82	4.39	53
54	53.87	3.77	53.85	4.00	53.83	4.24	53.81	4.47	54
55	54.87	3.84	54.85	4.08	54.83	4.32	54.81	4.55	55
56	55.86	3.91	55.85	4.15	55.83	4.39	55.81	4.64	56
57	56.86	3.98	56.84	4.22	56.82	4.47	56.80	4.72	57
58	57.86	4.05	57.84	4.30	57.82	4.55	57.80	4.80	58
59	58.86	4.12	58.84	4.37	58.82	4.63	58.60	4.89	59
60	59.85	4.19	59.84	4.45	59.82	4.71	59.79	4.97	60
61	60.85	4.26	60.83	4.52	60.81	4.79	60.79	5.05	61
62	61.85	4.32	61.83	4.59	61.81	4.86	61.79	5.13	62
63	62.85	4.39	62.83	4.67	62.81	4.94	62.78	5.22	63
64	63.84	4.46	63.82	4.74	63.80	5.02	63.78	5.30	64
65	64.84	4.53	64.82	4.82	64.80	5.10	64.78	5.38	65
66	65.84	4.60	65.82	4.89	65.80	5.18	65.77	5.47	66
67	66.84	4.67	66.82	4.97	66.79	5.26	66.77	5.55	67
68	67.83	4.74	67.81	5.04	67.79	5.34	67.77	5.63	68
69	68.83	4.81	68.81	5.11	68.79	5.41	68.76	5.71	69
70	69.83	4.88	69.81	5.19	69.78	5.49	69.76	5.80	70
71	70.83	4.95	70.80	5.26	70.78	5.57	70.76	5.88	71
72	71.82	5.02	71.80	5.34	71.78	5.65	71.75	5.96	72
73	72.82	5.09	72.80	5.41	72.77	5.73	72.75	6.04	73
74	73.82	5.16	73.80	5.48	73.77	5.81	73.75	6.13	74
75	74.82	5.23	74.79	5.56	74.77	5.88	74.74	6.21	75
76	75.81	5.30	75.79	5.63	75.77	5.96	75.74	6.29	76
77	76.81	5.37	76.79	5.71	76.76	6.04	76.74	6.38	77
78	77.81	5.44	77.79	5.78	77.76	6.12	77.73	6.46	78
79	78.81	5.51	78.78	5.85	78.76	6.20	78.73	6.54	79
80	79.81	5.58	79.78	5.93	79.75	6.28	79.73	6.62	80
81	80.80	5.65	80.78	6.00	80.75	6.36	80.72	6.71	81
82	81.80	5.72	81.78	6.08	81.75	6.43	81.72	6.79	82
83	82.80	5.79	82.77	6.15	82.74	6.51	82.71	6.87	83
84	83.80	5.86	83.77	6.23	83.74	6.59	83.71	6.96	84
85	84.79	5.93	84.77	6.30	84.74	6.67	84.71	7.04	85
86	85.79	6.00	85.76	6.37	85.73	6.75	85.70	7.12	86
87	86.79	6.07	86.76	6.45	86.73	6.83	86.70	7.20	87
88	87.79	6.14	87.76	6.52	87.73	6.90	87.70	7.29	88
89	88.78	6.21	88.76	6.60	88.73	6.98	88.70	7.37	89
90	89.78	6.28	89.75	6.67	89.72	7.06	89.69	7.45	90
91	90.78	6.35	90.75	6.74	90.72	7.14	90.69	7.54	91
92	91.78	6.42	91.75	6.82	91.72	7.22	91.68	7.62	92
93	92.77	6.49	92.74	6.89	92.71	7.30	92.68	7.70	93
94	93.77	6.56	93.74	6.97	93.71	7.38	93.68	7.78	94
95	94.77	6.63	94.74	7.04	94.71	7.45	94.67	7.87	95
96	95.77	6.70	95.74	7.11	95.70	7.53	95.67	7.95	96
97	96.76	6.77	96.73	7.19	96.70	7.61	96.67	8.03	97
98	97.76	6.84	97.73	7.26	97.70	7.69	97.66	8.12	98
99	98.76	6.91	98.73	7.34	98.69	7.77	98.66	8.20	99
100	99.76	6.98	99.73	7.41	99.69	7.85	99.66	8.28	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	86 Dəg.		85¾ Deg.		85½ Deg.		85¼ Deg		

Dist.	5 Deg.		5¼ Deg.		5½ Deg.		5¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	1.00	0.09	1.00	0.09	1.00	0.10	0.99	0.10	1
2	1.99	0.17	1.99	0.18	1.99	0.19	1.99	0.20	2
3	2.99	0.26	2.99	0.27	2.99	0.29	2.98	0.30	3
4	3.98	0.35	3.98	0.37	3.98	0.38	3.98	0.40	4
5	4.98	0.44	4.98	0.46	4.98	0.48	4.97	0.50	5
6	5.98	0.52	5.97	0.55	5.97	0.58	5.97	0.60	6
7	6.97	0.61	6.97	0.64	6.97	0.67	6.96	0.70	7
8	7.97	0.70	7.97	0.73	7.96	0.76	7.96	0.80	8
9	8.97	0.78	8.96	0.82	8.96	0.86	8.95	0.90	9
10	9.96	0.87	9.96	0.92	9.95	0.96	9.95	1.00	10
11	10.96	0.96	10.95	1.01	10.95	1.05	10.94	1.10	11
12	11.95	1.05	11.95	1.10	11.94	1.15	11.94	1.20	12
13	12.95	1.13	12.95	1.19	12.94	1.25	12.93	1.30	13
14	13.95	1.22	13.94	1.28	13.94	1.34	13.93	1.40	14
15	14.94	1.31	14.94	1.37	14.93	1.44	14.92	1.50	15
16	15.94	1.39	15.93	1.46	15.93	1.53	15.92	1.60	16
17	16.94	1.48	16.93	1.56	16.92	1.63	16.91	1.70	17
18	17.93	1.57	17.92	1.65	17.92	1.73	17.91	1.80	18
19	18.93	1.66	18.92	1.74	18.91	1.82	18.90	1.90	19
20	19.92	1.74	19.92	1.83	19.91	1.92	19.90	2.00	20
21	20.92	1.83	20.91	1.92	20.90	2.01	20.89	2.10	21
22	21.92	1.92	21.91	2.01	21.90	2.11	21.89	2.20	22
23	22.91	2.00	22.90	2.10	22.89	2.20	22.88	2.30	23
24	23.91	2.09	23.90	2.20	23.89	2.30	23.88	2.40	24
25	24.90	2.18	24.90	2.29	24.88	2.40	24.87	2.50	25
26	25.90	2.27	25.89	2.38	25.88	2.49	25.87	2.60	26
27	26.90	2.35	26.89	2.47	26.88	2.59	26.86	2.71	27
28	27.89	2.44	27.88	2.56	27.87	2.68	27.86	2.81	28
29	28.89	2.53	28.88	2.65	28.87	2.78	28.85	2.91	29
30	29.89	2.61	29.87	2.75	29.86	2.88	29.85	3.01	30
31	30.88	2.70	30.87	2.84	30.86	2.97	30.84	3.11	31
32	31.88	2.79	31.87	2.93	31.85	3.07	31.84	3.21	32
33	32.87	2.88	32.86	3.02	32.85	3.16	32.83	3.31	33
34	33.87	2.96	33.86	3.11	33.84	3.26	33.83	3.41	34
35	34.87	3.05	34.85	3.20	34.84	3.35	34.82	3.51	35
36	35.86	3.14	35.85	3.29	35.83	3.45	35.82	3.61	36
37	36.86	3.22	36.84	3.39	36.83	3.55	36.81	3.71	37
38	37.86	3.31	37.84	3.48	37.83	3.64	37.81	3.81	38
39	38.85	3.40	38.84	3.57	38.82	3.74	38.80	3.91	39
40	39.85	3.49	39.83	3.66	39.82	3.83	39.80	4.01	40
41	40.84	3.57	40.83	3.75	40.81	3.93	40.79	4.11	41
42	41.84	3.66	41.82	3.84	41.81	4.03	41.79	4.21	42
43	42.84	3.75	42.82	3.93	42.80	4.12	42.78	4.31	43
44	43.83	3.83	43.82	4.03	43.80	4.22	43.78	4.41	44
45	44.83	3.92	44.81	4.12	44.79	4.31	44.77	4.51	45
46	45.82	4.01	45.81	4.21	45.79	4.41	45.77	4.61	46
47	46.82	4.10	46.80	4.30	46.78	4.50	46.76	4.71	47
48	47.82	4.18	47.80	4.39	47.78	4.60	47.76	4.81	48
49	48.81	4.27	48.79	4.48	48.77	4.70	48.75	4.91	49
50	49.81	4.36	49.79	4.58	49.77	4.79	49.75	5.01	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	85 Deg.		84¾ Deg.		84½ Deg.		84¼ Deg.		

Dist.	5 Deg.		5¼ Deg.		5½ Deg.		5¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.81	4.44	50.79	4.67	50.77	4.89	50.74	5.11	51
52	51.80	4.53	51.78	4.76	51.76	4.98	51.74	5.21	52
53	52.80	4.62	52.78	4.85	52.76	5.08	52.73	5.31	53
54	53.79	4.71	53.77	4.94	53.75	5.18	53.73	5.41	54
55	54.79	4.79	54.77	5.03	54.75	5.27	54.72	5.51	55
56	55.79	4.88	55.77	5.12	55.74	5.37	55.72	5.61	56
57	56.78	4.97	56.76	5.22	56.74	5.46	56.71	5.71	57
58	57.78	5.06	57.76	5.31	57.73	5.56	57.71	5.81	58
59	58.78	5.14	58.75	5.40	58.73	5.65	58.70	5.91	59
60	59.77	5.23	59.75	5.49	59.72	5.75	59.70	6.01	60
61	60.77	5.32	60.74	5.58	60.72	5.85	60.69	6.11	61
62	61.76	5.40	61.74	5.67	61.71	5.94	61.69	6.21	62
63	62.76	5.49	62.74	5.76	62.71	6.04	62.68	6.31	63
64	63.76	5.58	63.73	5.86	63.71	6.13	63.68	6.41	64
65	64.75	5.67	64.73	5.95	64.70	6.23	64.67	6.51	65
66	65.75	5.75	65.72	6.04	65.70	6.33	65.67	6.61	66
67	66.75	5.84	66.72	6.13	66.69	6.42	66.66	6.71	67
68	67.74	5.93	67.71	6.22	67.69	6.52	67.66	6.81	68
69	68.74	6.01	68.71	6.31	68.68	6.61	68.65	6.91	69
70	69.73	6.10	69.71	6.41	69.68	6.71	69.65	7.01	70
71	70.73	6.19	70.70	6.50	70.67	6.81	70.64	7.11	71
72	71.73	6.28	71.70	6.59	71.67	6.90	71.64	7.21	72
73	72.72	6.36	72.69	6.68	72.66	7.00	72.63	7.31	73
74	73.72	6.45	73.69	6.77	73.66	7.09	73.63	7.41	74
75	74.71	6.54	74.69	6.86	74.65	7.19	74.62	7.51	75
76	75.71	6.62	75.68	6.95	75.65	7.28	75.62	7.61	76
77	76.71	6.71	76.68	7.05	76.65	7.38	76.61	7.71	77
78	77.70	6.80	77.67	7.14	77.64	7.48	77.61	7.81	78
79	78.70	6.89	78.67	7.23	78.64	7.57	78.60	7.91	79
80	79.70	6.97	79.66	7.32	79.63	7.67	79.60	8.02	80
81	80.69	7.06	80.66	7.41	80.63	7.76	80.59	8.12	81
82	81.69	7.15	81.66	7.50	81.62	7.86	81.59	8.22	82
83	82.68	7.23	82.65	7.59	82.62	7.96	82.58	8.32	83
84	83.68	7.32	83.65	7.69	83.61	8.05	83.58	8.42	84
85	84.68	7.41	84.64	7.78	84.61	8.15	84.57	8.52	85
86	85.67	7.50	85.64	7.87	85.60	8.24	85.57	8.62	86
87	86.67	7.58	86.64	7.96	86.60	8.34	86.56	8.72	87
88	87.67	7.67	87.63	8.05	87.59	8.44	87.56	8.82	88
89	88.66	7.76	88.63	8.14	88.59	8.53	88.55	8.92	89
90	89.66	7.84	89.62	8.24	89.59	8.63	89.55	9.02	90
91	90.65	7.93	90.62	8.33	90.58	8.72	90.54	9.12	91
92	91.65	8.02	91.61	8.42	91.58	8.82	91.54	9.22	92
93	92.65	8.11	92.61	8.51	92.57	8.91	92.53	9.32	93
94	93.64	8.19	93.61	8.60	93.57	9.01	93.53	9.42	94
95	94.64	8.28	94.60	8.69	94.56	9.11	94.52	9.52	95
96	95.63	8.37	95.60	8.78	95.56	9.20	95.52	9.62	96
97	96.63	8.45	96.59	8.88	96.55	9.30	96.51	9.72	97
98	97.63	8.54	97.59	8.97	97.55	9.39	97.51	9.82	98
99	98.62	8.63	98.59	9.06	98.54	9.49	98.50	9.92	99
100	99.62	8.72	99.58	9.15	99.54	9.58	99.50	10.02	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	85 Deg.		84¾ Deg.		84½ Deg.		84¼ Deg.		

Diſt.	6 Deg.		6¼ Deg.		6½ Deg.		6¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.99	0.10	0.99	0.11	0.99	0.11	0.99	0.12	1
2	1.99	0.21	1.99	0.22	1.99	0.23	1.99	0.24	2
3	2.98	0.31	2.98	0.33	2.98	0.34	2.98	0.35	3
4	3.98	0.41	3.98	0.44	3.97	0.45	3.97	0.47	4
5	4.97	0.52	4.97	0.54	4.97	0.57	4.97	0.59	5
6	5.97	0.63	5.96	0.65	5.96	0.68	5.96	0.71	6
7	6.96	0.73	6.96	0.76	6.96	0.79	6.95	0.82	7
8	7.96	0.84	7.95	0.87	7.95	0.91	7.94	0.94	8
9	8.95	0.94	8.95	0.98	8.94	1.02	8.94	1.06	9
10	9.95	1.05	9.94	1.09	9.94	1.13	9.93	1.18	10
11	10.94	1.15	10.93	1.20	10.93	1.25	10.92	1.29	11
12	11.93	1.25	11.93	1.31	11.92	1.36	11.92	1.41	12
13	12.93	1.36	12.92	1.42	12.92	1.47	12.91	1.53	13
14	13.92	1.46	13.92	1.52	13.91	1.59	13.90	1.65	14
15	14.92	1.57	14.91	1.63	14.90	1.70	14.90	1.76	15
16	15.91	1.67	15.90	1.74	15.90	1.81	15.89	1.88	16
17	16.91	1.78	16.90	1.85	16.89	1.92	16.88	2.00	17
18	17.90	1.88	17.89	1.96	17.88	2.04	17.88	2.12	18
19	18.90	1.99	18.89	2.07	18.88	2.15	18.87	2.23	19
20	19.89	2.09	19.88	2.18	19.87	2.26	19.86	2.35	20
21	20.88	2.20	20.88	2.29	20.87	2.38	20.85	2.47	21
22	21.88	2.30	21.87	2.40	21.86	2.49	21.85	2.59	22
23	22.87	2.40	22.86	2.50	22.85	2.60	22.84	2.70	23
24	23.87	2.51	23.86	2.61	23.85	2.72	23.83	2.82	24
25	24.86	2.61	24.85	2.72	24.84	2.83	24.83	2.94	25
26	25.86	2.72	25.85	2.83	25.83	2.94	25.82	3.06	26
27	26.85	2.82	26.84	2.94	26.83	3.06	26.81	3.17	27
28	27.85	2.93	27.83	3.05	27.82	3.17	27.81	3.29	28
29	28.84	3.03	28.83	3.16	28.81	3.28	28.80	3.41	29
30	29.84	3.14	29.82	3.27	29.81	3.40	29.79	3.53	30
31	30.83	3.24	30.82	3.37	30.80	3.51	30.79	3.64	31
32	31.82	3.34	31.81	3.48	31.79	3.62	31.78	3.76	32
33	32.82	3.45	32.80	3.59	32.79	3.74	32.77	3.88	33
34	33.81	3.55	33.80	3.70	33.78	3.85	33.76	4.00	34
35	34.81	3.66	34.79	3.81	34.78	3.96	34.76	4.11	35
36	35.80	3.76	35.79	3.92	35.77	4.08	35.75	4.23	36
37	36.80	3.87	36.78	4.03	36.76	4.19	36.75	4.35	37
38	37.79	3.97	37.77	4.14	37.76	4.30	37.74	4.47	38
39	38.79	4.08	38.77	4.25	38.75	4.41	38.73	4.58	39
40	39.78	4.18	39.76	4.35	39.74	4.53	39.72	4.70	40
41	40.78	4.29	40.76	4.46	40.74	4.64	40.72	4.82	41
42	41.77	4.39	41.75	4.57	41.73	4.76	41.71	4.94	42
43	42.76	4.49	42.74	4.68	42.72	4.87	42.70	5.05	43
44	43.76	4.60	43.74	4.79	43.72	4.98	43.70	5.17	44
45	44.75	4.70	44.73	4.90	44.71	5.09	44.69	5.29	45
46	45.75	4.81	45.73	5.01	45.70	5.21	45.68	5.41	46
47	46.74	4.91	46.72	5.12	46.70	5.32	46.67	5.52	47
48	47.74	5.02	47.71	5.23	47.69	5.43	47.67	5.64	48
49	48.73	5.12	48.71	5.34	48.69	5.55	48.66	5.76	49
50	49.73	5.23	49.70	5.44	49.68	5.66	49.65	5.88	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	84 Deg.		83¾ Deg.		83½ Deg.		83¼ Deg.		

Diſt.	6 Deg.		6¼ Deg.		6½ Deg.		6¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.72	5.33	50.70	5.55	50.67	5.77	50.65	5.99	51
52	51.72	5.44	51.69	5.66	51.67	5.89	51.64	6.11	52
53	52.71	5.54	52.68	5.77	52.66	6.00	52.63	6.23	53
54	53.70	5.64	53.68	5.88	53.65	6.11	53.63	6.35	54
55	54.70	5.75	54.67	5.99	54.65	6.23	54.62	6.46	55
56	55.69	5.85	55.67	6.10	55.64	6.34	55.61	6.58	56
57	56.69	5.96	56.66	6.21	56.63	6.45	56.60	6.70	57
58	57.68	6.06	57.66	6.31	57.63	6.57	57.60	6.82	58
59	58.68	6.17	58.65	6.42	58.62	6.68	58.59	6.93	59
60	59.67	6.27	59.64	6.53	59.61	6.79	59.58	7.05	60
61	60.67	6.38	60.64	6.64	60.61	6.91	60.58	7.17	61
62	61.66	6.48	61.63	6.75	61.60	7.02	61.57	7.29	62
63	62.65	6.59	62.63	6.86	62.60	7.13	62.56	7.40	63
64	63.65	6.69	63.62	6.97	63.59	7.25	63.56	7.52	64
65	64.64	6.79	64.61	7.08	64.58	7.36	64.55	7.64	65
66	65.64	6.90	65.61	7.19	65.58	7.47	65.54	7.76	66
67	66.63	7.00	66.60	7.29	66.57	7.58	66.54	7.88	67
68	67.63	7.11	67.60	7.40	67.56	7.70	67.53	7.99	68
69	68.62	7.21	68.59	7.51	68.56	7.81	68.52	8.11	69
70	69.62	7.32	69.58	7.62	69.55	7.92	69.51	8.23	70
71	70.61	7.42	70.58	7.73	70.54	8.04	70.51	8.35	71
72	71.61	7.53	71.57	7.84	71.54	8.15	71.50	8.46	72
73	72.60	7.63	72.57	7.95	72.53	8.26	72.49	8.58	73
74	73.59	7.74	73.56	8.06	73.52	8.38	73.49	8.70	74
75	74.59	7.84	74.55	8.17	74.52	8.49	74.48	8.82	75
76	75.58	7.94	75.55	8.27	75.51	8.60	75.47	8.93	76
77	76.58	8.05	76.54	8.38	76.51	8.72	76.47	9.05	77
78	77.57	8.15	77.54	8.49	77.50	8.83	77.46	9.17	78
79	78.57	8.26	78.53	8.60	78.49	8.94	78.45	9.29	79
80	79.56	8.36	79.53	8.71	79.49	9.06	79.45	9.40	80
81	80.56	8.47	80.52	8.82	80.48	9.17	80.44	9.52	81
82	81.55	8.57	81.51	8.93	81.47	9.28	81.43	9.64	82
83	82.55	8.68	82.51	9.04	82.47	9.40	82.42	9.76	83
84	83.54	8.78	83.50	9.14	83.46	9.51	83.42	9.87	84
85	84.53	8.88	84.50	9.25	84.45	9.62	84.41	9.99	85
86	85.53	8.99	85.49	9.36	85.45	9.74	85.40	10.11	86
87	86.52	9.09	86.48	6.47	86.44	9.85	86.40	10.23	87
88	87.52	9.20	87.48	9.58	87.43	9.96	87.39	10.34	88
89	88.51	9.30	88.47	9.69	88.43	10.08	88.38	10.46	89
90	89.51	9.41	89.47	9.80	89.42	10.19	89.38	10.58	90
91	90.50	9.51	90.46	9.91	90.42	10.30	90.37	10.70	91
92	91.50	9.62	91.45	10.02	91.41	10.41	91.36	10.81	92
93	92.49	9.72	92.45	10.12	92.40	10.53	92.36	10.93	93
94	93.49	9.83	93.44	10.23	93.40	10.64	93.35	11.05	94
95	94.48	9.93	94.44	10.34	94.39	10.75	94.34	11.17	95
96	95.47	10.03	95.43	10.45	95.38	10.87	95.33	11.28	96
97	96.47	10.14	96.42	10.56	96.38	10.98	96.33	11.40	97
98	97.46	10.24	97.42	10.67	97.37	11.09	97.32	11.52	98
99	98.46	10.35	98.41	10.78	98.36	11.21	98.31	11.64	99
100	99.45	10.45	99.41	10.89	99.36	11.32	99.31	11.75	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	84 Deg.		83¾ Deg.		83½ Deg.		83¼ Deg.		

Dist.	7 Deg.		7¼ Deg.		7½ Deg.		7¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,99	0,12	0,99	0,13	0,99	0,13	0,99	0,13	1
2	1,99	0,24	1,98	0,25	1,98	0,26	1,98	0,27	2
3	2,98	0,37	2,98	0,38	2,97	0,39	2,97	0,40	3
4	3,97	0,49	3,97	0,50	3,97	0,52	3,96	0,54	4
5	4,96	0,61	4,96	0,63	4,96	0,65	4,95	0,67	5
6	5,96	0,73	5,95	0,76	5,95	0,78	5,95	0,81	6
7	6,95	0,85	6,94	0,88	6,94	0,91	6,94	0,94	7
8	7,94	0,97	7,94	1,01	7,93	1,04	7,93	1,08	8
9	8,93	1,10	8,93	1,14	8,92	1,17	8,92	1,21	9
10	9,93	1,22	9,92	1,26	9,91	1,31	9,91	1,35	10
11	10,92	1,34	10,91	1,39	10,91	1,44	10,90	1,48	11
12	11,91	1,46	11,90	1,51	11,90	1,57	11,89	1,62	12
13	12,90	1,58	12,90	1,64	12,89	1,70	12,88	1,75	13
14	13,90	1,71	13,89	1,77	13,88	1,83	13,87	1,89	14
15	14,89	1,83	14,88	1,89	14,87	1,96	14,86	2,02	15
16	15,88	1,95	15,87	2,02	15,86	2,09	15,85	2,16	16
17	16,87	2,07	16,86	2,15	16,85	2,22	16,84	2,29	17
18	17,87	2,19	17,86	2,27	17,85	2,35	17,84	2,43	18
19	18,86	2,32	18,85	2,40	18,84	2,48	18,83	2,56	19
20	19,85	2,44	19,84	2,52	19,83	2,61	19,82	2,70	20
21	20,84	2,56	20,83	2,65	20,82	2,74	20,81	2,83	21
22	21,84	2,68	21,82	2,78	21,81	2,87	21,80	2,97	22
23	22,83	2,80	22,82	2,90	22,80	3,00	22,79	3,10	23
24	23,82	2,92	23,81	3,03	23,79	3,13	23,78	3,24	24
25	24,81	3,05	24,80	3,15	24,79	3,26	24,77	3,37	25
26	25,81	3,17	25,79	3,28	25,78	3,39	25,76	3,51	26
27	26,80	3,29	26,78	3,41	26,77	3,52	26,75	3,64	27
28	27,79	3,41	27,78	3,53	27,76	3,65	27,74	3,78	28
29	28,78	3,53	28,77	3,66	28,75	3,79	28,74	3,91	29
30	29,78	3,66	29,76	3,79	29,74	3,92	29,73	4,05	30
31	30,77	3,78	30,75	3,91	30,73	4,05	30,72	4,18	31
32	31,76	3,90	31,74	4,04	31,73	4,18	31,71	4,32	32
33	32,75	4,02	32,74	4,16	32,72	4,31	32,70	4,45	33
34	33,75	4,14	33,73	4,29	33,71	4,44	33,69	4,58	34
35	34,74	4,27	34,72	4,42	34,70	4,57	34,68	4,72	35
36	35,73	4,39	35,71	4,54	35,69	4,70	35,67	4,85	36
37	36,72	4,51	36,70	4,67	36,68	4,83	36,66	4,99	37
38	37,72	4,63	37,70	4,80	37,67	4,96	37,65	5,12	38
39	38,71	4,75	38,69	4,92	38,67	5,09	38,64	5,26	39
40	39,70	4,87	39,68	5,05	39,66	5,22	39,63	5,39	40
41	40,70	5,00	40,67	5,17	40,65	5,35	40,63	5,53	41
42	41,69	5,12	41,66	5,30	41,64	5,48	41,62	5,66	42
43	42,68	5,24	42,66	5,43	42,63	5,61	42,61	5,80	43
44	43,67	5,36	43,65	5,55	43,62	5,74	43,60	5,93	44
45	44,67	5,48	44,64	5,68	44,62	5,87	44,59	6,07	45
46	45,66	5,61	45,63	5,81	45,61	6,00	45,58	6,20	46
47	46,65	5,73	46,62	5,93	46,60	6,13	46,57	6,34	47
48	47,64	5,85	47,62	6,06	47,59	6,27	47,56	6,47	48
49	48,63	5,97	48,61	6,18	48,58	6,40	48,55	6,61	49
50	49,63	6,09	49,60	6,31	49,57	6,53	49,54	6,74	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	83 Deg		82¾ Deg		82½ Deg.		82¼ Deg.		

Diſt.	7 Deg.		7¼ Deg.		7½ Deg.		7¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.62	6.22	50.59	6.44	50.56	6.66	50.53	6.88	51
52	51.61	6.34	51.58	6.56	51.56	6.79	51.53	7.01	52
53	52.60	6.46	52.58	6.09	52.55	6.92	52.52	7.15	53
54	53.60	6.58	53.57	6.81	53.54	7.05	53.51	7.28	54
55	54.59	6.70	54.56	6.94	54.53	7.18	54.50	7.42	55
56	55.58	6.82	55.55	7.07	55.52	7.31	55.49	7.55	56
57	56.58	6.95	56.54	7.19	56.51	7.44	56.48	7.69	57
58	57.57	7.07	57.54	7.32	57.50	7.57	57.47	7.82	58
59	58.56	7.19	58.53	7.45	58.50	7.70	58.46	7.96	59
60	59.55	7 31	59.52	7.57	59.49	7.83	59.45	8.09	60
61	60.55	7.43	60.51	7.70	60.48	7.96	60.44	8.23	61
62	61.54	7.56	61.50	7.82	61.47	8.09	61.43	8.36	62
63	62.53	7.68	62.50	7.95	62.46	8.22	62.42	8.50	63
64	63.52	7.80	63.49	8.08	63.45	8.35	63.42	8.63	64
65	64.52	7.92	64.48	8.20	64.44	8.48	64.41	8.77	65
66	65.51	8.04	65.47	8.33	65.44	8.61	65.40	8.90	66
67	66.50	8.17	66.46	8.46	66.43	8.75	66.39	9.04	67
68	67.49	8.29	67.46	8.58	67.42	8.88	67.38	9.17	68
69	68.49	8.41	68.45	8.71	68.41	9.01	68.37	9.30	69
70	69.48	8.53	69.44	8.83	69.40	9.14	69.36	9.44	70
71	70.47	8.65	70.43	8.96	70.39	9.27	70.35	9.57	71
72	71.46	8.77	71.42	9.09	71.38	9.40	71.34	9.71	72
73	72.46	8.90	72.42	9.21	72.38	9.53	72.33	9.84	73
74	73.45	9.02	73.41	9.34	73.37	9.66	73.32	9.98	74
75	74.44	9.14	74.40	9.46	74.36	9.79	74.31	10.11	75
76	75.43	9.26	75.39	9.59	75.35	9.92	75.31	10.25	76
77	76.43	9.38	76.38	9.72	76.34	10.05	76.30	10.38	77
78	77.42	9.51	77.38	9.84	77.33	10.18	77.29	10.52	78
79	78.41	9.63	78.37	9.97	78.32	10.31	78.28	10.65	79
80	79.40	9.75	79.36	10.10	79.32	10.44	79.27	10.79	80
81	80.40	9.87	80.35	10.22	80.31	10.57	80.26	10.92	81
82	81.39	9.99	81.34	10.35	81.30	10.70	81.25	11.06	82
83	82.38	10.12	82.34	10.47	82.29	10.83	82.24	11.19	83
84	83.37	10.24	83.33	10.60	83.28	10.96	83.23	11.33	84
85	84.37	10.36	84.32	10.73	84.27	11.09	84.22	11.46	85
86	85.36	10.48	85.31	10.85	85.26	11.23	85.21	11.60	86
87	86.35	10.60	86.30	10.98	86.26	11.36	86.21	11.73	87
88	87.34	10.72	87.30	11.11	87.25	11.49	87.20	11.87	88
89	88.34	10.85	88.29	11.23	88.24	11.62	88.19	12.00	89
90	89.33	10.97	89.28	11.36	89.23	11.75	89.18	12.14	90
91	90.32	11.09	90.27	11.48	90.22	11.88	90.17	12.27	91
92	91.31	11.21	91.26	11.61	91.21	12.01	91.16	12.41	92
93	92.31	11.33	92.26	11.74	92.20	12.14	92.15	12.54	93
94	93.30	11.46	93.25	11.86	93.20	12.27	93.14	12.68	94
95	94.29	11.58	94.24	11.99	94.19	12.40	94.13	12.81	95
96	95.28	11.70	95.23	12.12	95.18	12.53	95.12	12.95	96
97	96.28	11.82	96.22	12.24	96.17	12.66	96.11	13.08	97
98	97.27	11.94	97.22	12.37	97.16	12.79	97.10	13.22	98
99	98.26	12.07	98.21	12.49	98.15	12.92	98.10	13.35	99
100	99.25	12.19	99.20	12.62	99.14	13.05	99.09	13.49	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Diſt.	83 Deg		82¾ Deg.		82½ Deg.		82¼ Deg.		Diſt.

Dist.	8 Deg.		8¼ Deg.		8½ Deg.		8¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.99	0.14	0.99	0.14	0.99	0.15	0.99	0.15	1
2	1.98	0.28	1.98	0.29	1.98	0.30	1.98	0.30	2
3	2.97	0.42	2.97	0.43	2.97	0.44	2.97	0.46	3
4	3.96	0.56	3.96	0.57	3.96	0.59	3.95	0.61	4
5	4.95	0.70	4.95	0.72	4.95	0.74	4.94	0.76	5
6	5.94	0.84	5.94	0.86	5.93	0.89	5.93	0.91	6
7	6.93	0.97	6.93	1.00	6.92	1.03	6.92	1.06	7
8	7.92	1.11	7.92	1.15	7.91	1.18	7.91	1.22	8
9	8.91	1.25	8.91	1.29	8.90	1.33	8.90	1.37	9
10	9.90	1.39	9.90	1.43	9.89	1.48	9.88	1.52	10
11	10.89	1.53	10.89	1.58	10.88	1.63	10.87	1.67	11
12	11.88	1.67	11.88	1.72	11.87	1.77	11.86	1.83	12
13	12.87	1.81	12.87	1.87	12.86	1.92	12.85	1.98	13
14	13.86	1.95	13.86	2.01	13.85	2.07	13.84	2.13	14
15	14.85	2.04	14.85	2.15	14.84	2.22	14.83	2.28	15
16	15.84	2.23	15.84	2.30	15.82	2.36	15.81	2.43	16
17	16.83	2.32	16.83	2.44	16.81	2.51	16.80	2.59	17
18	17.82	2.51	17.81	2.58	17.80	2.66	17.79	2.74	18
19	18.82	2.64	18.80	2.73	18.79	2.81	18.78	2.89	19
20	19.81	2.78	19.79	2.87	19.78	2.96	19.77	3.04	20
21	20.80	2.92	20.78	3.01	20.77	3.10	20.76	3.19	21
22	21.79	3.06	21.77	3.16	21.76	3.25	21.74	3.35	22
23	22.78	3.20	22.76	3.30	22.75	3.40	22.73	3.50	23
24	23.77	3.34	23.75	3.44	23.74	3.55	23.72	3.65	24
25	24.76	3.48	24.74	3.59	24.73	3.70	24.71	3.80	25
26	25.75	3.62	25.73	3.73	25.71	3.84	25.70	3.96	26
27	26.74	3.76	26.72	3.87	26.70	3.99	26.69	4.11	27
28	27.73	3.90	27.71	4.02	27.69	4.14	27.67	4.26	28
29	28.72	4.04	28.70	4.16	28.68	4.29	28.66	4.41	29
30	29.71	4.18	29.69	4.30	29.67	4.43	29.65	4.56	30
31	30.70	4.31	30.68	4.45	30.66	4.58	30.64	4.72	31
32	31.69	4.45	31.67	4.59	31.65	4.73	31.63	4.87	32
33	32.68	4.59	32.66	4.74	32.64	4.88	32.62	5.02	33
34	33.67	4.73	33.65	4.88	33.63	5.03	33.60	5.17	34
35	34.66	4.87	34.64	5.02	34.62	5.17	34.59	5.32	35
36	35.65	5.01	35.63	5.17	35.60	5.32	35.58	5.48	36
37	36.64	5.15	36.62	5.31	36.59	5.47	36.57	5.63	37
38	37.63	5.29	37.61	5.45	37.58	5.62	37.56	5.78	38
39	38.62	5.43	38.60	5.60	38.57	5.76	38.55	5.93	39
40	39.61	5.57	39.59	5.74	39.56	5.91	39.53	6.08	40
41	40.60	5.71	40.58	5.88	40.55	6.06	40.52	6.24	41
42	41.59	5.85	41.57	6.03	41.54	6.21	41.51	6.39	42
43	42.58	5.98	42.56	6.17	42.53	6.36	42.50	6.54	43
44	43.57	6.12	43.54	6.31	43.52	6.50	43.49	6.69	44
45	44.56	6.26	44.53	6.46	44.51	6.65	44.48	6.85	45
46	45.55	6.40	45.52	6.60	45.49	6.80	45.46	7.00	46
47	46.54	6.54	46.51	6.74	46.48	6.95	46.45	7.15	47
48	47.53	6.68	47.50	6.89	47.47	7.09	47.44	7.30	48
49	48.52	6.82	48.49	7.03	48.46	7.24	48.43	7.45	49
50	49.51	6.96	49.48	7.17	49.45	7.39	49.42	7.61	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	82 Deg.		81¾ Deg.		81½ Deg.		81¼ Deg.		

Dist.	8 Deg.		8¼ Deg.		8½ Deg.		8¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.50	7.10	50.47	7.32	50.44	7.54	50.41	7.76	51
52	51.49	7.24	51.46	7.46	51.43	7.69	51.39	7.91	52
53	52.48	7.38	52.45	7.61	52.42	7.83	52.38	8.06	53
54	53.47	7.52	53.44	7.75	53.41	7.98	53.37	8.21	54
55	54.46	7.65	54.43	7.89	54.40	8.13	54.36	8.37	55
56	55.46	7.79	55.42	8.04	55.38	8.28	55.35	8.52	56
57	56.45	7.93	56.41	8.18	56.37	8.43	56.34	8.67	57
58	57.44	8.07	57.40	8.32	57.36	8.57	57.32	8.82	58
59	58.43	8.21	58.39	8.47	58.35	8.72	58.31	8.98	59
60	59.42	8.35	59.38	8.61	59.34	8.87	59.30	9.13	60
61	60.41	8.49	60.37	8.75	60.33	9.02	60.29	9.28	61
62	61.40	8.63	61.36	8.90	61.32	9.16	61.28	9.43	62
63	62.39	8.77	62.35	9.04	62.31	9.31	62.27	9.58	63
64	63.38	8.91	63.34	9.18	63.30	9.46	63.26	9.74	64
65	64.37	9.05	64.33	9.33	64.29	9.61	64.24	9.89	65
66	65.36	9.19	65.32	9.47	65.28	9.76	65.23	10.04	66
67	66.35	9.32	66.31	9.61	66.26	9.90	66.22	10.19	67
68	67.34	9.46	67.30	9.76	67.25	10.05	67.21	10.34	68
69	68.33	9.60	68.29	9.90	68.24	10.20	68.20	10.50	69
70	69.32	9.74	69.28	10.04	69.23	10.35	69.19	10.65	70
71	70.31	9.88	70.27	10.19	70.22	10.49	70.17	10.80	71
72	71.30	10.02	71.25	10.33	71.21	10.64	71.16	10.95	72
73	72.29	10.16	72.24	10.47	72.20	10.79	72.15	11.10	73
74	73.28	10.30	73.23	10.62	73.19	10.94	73.14	11.26	74
75	74.27	10.44	74.22	10.76	74.18	11.09	74.13	11.41	75
76	75.26	10.58	75.21	10.91	75.17	11.23	75.12	11.56	76
77	76.25	10.72	76.20	11.05	76.15	11.38	76.10	11.71	77
78	77.24	10.86	77.19	11.19	77.14	11.53	77.09	11.87	78
79	78.23	10.99	78.18	11.34	78.13	11.68	78.06	12.02	79
80	79.22	11.13	79.17	11.48	79.12	11.82	79.07	12.17	80
81	80.21	11.27	80.16	11.62	80.11	11.97	80.06	12.32	81
82	81.20	11.41	81.15	11.77	81.10	12.12	81.05	12.47	82
83	82.19	11.55	82.14	11.91	82.09	12.27	82.03	12.63	83
84	83.18	11.69	83.13	12.05	83.08	12.42	83.02	12.78	84
85	84.17	11.83	84.12	12.20	84.07	12.56	84.01	12.93	85
86	85.16	11.97	85.11	12.34	85.06	12.71	85.00	13.08	86
87	86.15	12.11	86.10	12.48	86.04	12.86	85.99	13.23	87
88	87.14	12.25	87.09	12.63	87.03	13.01	86.98	13.39	88
89	88.13	12.39	88.08	12.77	88.02	13.16	87.96	13.54	89
90	89.12	12.53	89.07	12.91	89.01	13.30	88.95	13.69	90
91	90.11	12.66	90.06	13.06	90.00	13.45	89.94	13.84	91
92	91.10	12.80	91.05	13.20	90.99	13.60	90.93	14.00	92
93	92.09	12.94	92.04	13.34	91.98	13.75	91.92	14.15	93
94	93.09	13.08	93.03	13.49	92.97	13.89	92.91	14.30	94
95	94.08	13.22	94.02	13.63	93.96	14.04	93.89	14.45	95
96	95.07	13.36	95.01	13.78	94.95	14.19	94.88	14.60	96
97	96.06	13.50	96.00	13.92	95.93	14.34	95.87	14.76	97
98	97.05	13.64	96.99	14.06	96.92	14.49	96.86	14.91	98
99	98.04	13.78	97.98	14.21	97.91	14.63	97.85	15.06	99
100	99.03	13.92	98.97	14.35	98.90	14.78	98.84	15.21	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	82 Deg.		81¾ Deg.		81½ Deg.		81¼ Deg.		Dist.

Dist.	9 Deg.		9¼ Deg.		9½ Deg.		9¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.99	0.16	0.99	0.16	0.99	0.17	0.99	0.17	1
2	1.98	0.31	1.97	0.32	1.97	0.33	1.97	0.34	2
3	2.96	0.47	2.96	0.48	2.96	0.50	2.96	0.51	3
4	3.95	0.63	3.95	0.64	3.95	0.66	3.94	0.68	4
5	4.94	0.78	4.93	0.80	4.93	0.83	4.93	0.85	5
6	5.93	0.94	5.92	0.96	5.92	0.99	5.91	1.02	6
7	6.91	1.10	6.91	1.13	6.90	1.16	6.90	1.19	7
8	7.90	1.25	7.90	1.29	7.89	1.32	7.88	1.35	8
9	8.89	1.41	8.88	1.45	8.88	1.49	8.87	1.52	9
10	9.88	1.56	9.87	1.61	9.86	1.65	9.86	1.69	10
11	10.86	1.72	10.86	1.77	10.85	1.82	10.84	1.86	11
12	11.85	1.88	11.84	1.93	11.84	1.98	11.83	2.03	12
13	12.84	2.03	12.83	2.09	12.82	2.15	12.81	2.20	13
14	13.83	2.19	13.82	2.25	13.81	2.31	13.80	2.37	14
15	14.82	2.35	14.80	2.41	14.79	2.48	14.78	2.54	15
16	15.80	2.50	15.79	2.57	15.78	2.64	15.77	2.71	16
17	16.79	2.66	16.78	2.73	16.77	2.81	16.75	2.88	17
18	17.78	2.82	17.77	2.89	17.75	2.97	17.74	3.05	18
19	18.77	2.97	18.75	3.05	18.74	3.14	18.73	3.22	19
20	19.75	3.13	19.74	3.21	19.73	3.30	19.71	3.39	20
21	20.74	3.29	20.73	3.38	20.71	3.47	20.70	3.56	21
22	21.73	3.44	21.71	3.54	21.70	3.63	21.68	3.73	22
23	22.72	3.60	22.70	3.70	22.68	3.80	22.67	3.90	23
24	23.70	3.75	23.69	3.86	23.67	3.96	23.65	4.06	24
25	24.69	3.91	24.67	4.02	24.66	4.13	24.64	4.23	25
26	25.68	4.07	25.66	4.18	25.64	4.29	25.62	4.40	26
27	26.67	4.22	26.65	4.34	26.63	4.46	26.61	4.57	27
28	27.66	4.38	27.64	4.50	27.62	4.62	27.60	4.74	28
29	28.64	4.54	28.62	4.66	28.60	4.79	28.58	4.91	29
30	29.63	4.69	29.61	4.82	29.59	4.95	29.57	5.08	30
31	30.62	4.85	30.60	4.98	30.57	5.12	30.55	5.25	31
32	31.61	5.01	31.58	5.14	31.56	5.28	31.54	5.42	32
33	32.59	5.16	32.57	5.30	32.55	5.45	32.52	5.59	33
34	33.58	5.32	33.56	5.47	33.53	5.61	33.51	5.76	34
35	34.57	5.48	34.54	5.63	34.52	5.78	34.49	5.93	35
36	35.56	5.63	35.53	5.79	35.51	5.94	35.48	6.10	36
37	36.54	5.79	36.52	5.95	36.49	6.11	36.47	6.27	37
38	37.53	5.94	37.51	6.11	37.48	6.27	37.45	6.44	38
39	38.52	6.10	38.49	6.27	38.47	6.44	38.44	6.60	39
40	39.51	6.26	39.48	6.43	39.45	6.60	39.42	6.77	40
41	40.50	6.41	40.47	6.59	40.44	6.77	40.41	6.94	41
42	41.48	6.57	41.45	6.75	41.42	6.92	41.39	7.11	42
43	42.47	6.73	42.44	6.91	42.41	7.10	42.38	7.28	43
44	43.46	6.88	43.43	7.07	43.40	7.26	43.36	7.45	44
45	44.45	7.04	44.41	7.23	44.38	7.43	44.35	7.62	45
46	45.43	7.20	45.40	7.39	45.37	7.59	45.34	7.79	46
47	46.42	7.35	46.39	7.55	46.36	7.76	46.32	7.96	47
48	47.41	7.51	47.38	7.72	47.34	7.92	47.31	8.13	48
49	48.40	7.67	48.36	7.88	48.33	8.09	48.29	8.30	49
50	49.38	7.82	49.35	8.04	49.32	8.25	49.28	8.47	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	81 Deg.		80¾ Deg.		80½ Deg.		80¼ Deg.		Dist.

Dist.	9 Deg.		9¼ Deg.		9½ Deg.		9¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.37	7.98	50.34	8.20	50.30	8.42	50.26	8.64	51
52	51.36	8.13	51.32	8.36	51.29	8.58	51.25	8.81	52
53	52.35	8.29	52.31	8.52	52.27	8.75	52.23	8.98	53
54	53.34	8.45	53.30	8.68	53.26	8.91	53.22	9.14	54
55	54.32	8.60	54.28	8.84	54.25	9.08	54.21	9.31	55
56	55.31	8.76	55.27	9.00	55.23	9.24	55.19	9.48	56
57	56.30	8.92	56.26	9.16	56.22	9.41	56.18	9.65	57
58	57.29	9.07	57.25	9.32	57.20	9.57	57.16	9.82	58
59	58.27	9.23	58.23	9.48	58.19	9.74	58.15	9.99	59
60	59.26	9.39	59.22	9.64	59.18	9.90	59.13	10.16	60
61	60.25	9.54	60.21	9.81	60.16	10.07	60.12	10.33	61
62	61.24	9.70	61.19	9.97	61.15	10.23	61.10	10.50	62
63	62.22	9.86	62.18	10.13	62.14	10.40	62.09	10.67	63
64	63.21	10.01	63.17	10.29	63.12	10.56	63.08	10.84	64
65	64.20	10.17	64.15	10.45	64.11	10.73	64.06	11.01	65
66	65.19	10.32	65.14	10.61	65.09	10.89	65.05	11.18	66
67	66.18	10.48	66.13	10.77	66.08	11.06	66.03	11.35	67
68	67.16	10.64	67.12	10.93	67.07	11.22	67.02	11.52	68
69	68.15	10.79	68.10	11.09	68.05	11.39	68.00	11.69	69
70	69.14	10.95	69.09	11.25	69.04	11.55	68.99	11.85	70
71	70.13	11.11	70.08	11.41	70.03	11.72	69.97	12.02	71
72	71.11	11.26	71.06	11.57	71.01	11.88	70.90	12.19	72
73	72.10	11.42	72.05	11.73	72.00	12.05	71.95	12.36	73
74	73.09	11.58	73.04	11.89	72.99	12.21	72.93	12.53	74
75	74.08	11.73	74.02	12.06	73.97	12.38	73.92	12.70	75
76	75.06	11.89	75.01	12.22	74.96	12.54	74.90	12.87	76
77	76.05	12.05	76.00	12.38	75.94	12.71	75.89	13.04	77
78	77.04	12.20	76.99	12.54	76.93	12.87	76.87	13.21	78
79	78.03	12.36	77.97	12.70	77.92	13.04	77.86	13.38	79
80	79.02	12.51	78.96	12.86	78.90	13.20	78.84	13.55	80
81	80.00	12.67	79.95	13.02	79.89	13.37	79.83	13.72	81
82	80.99	12.83	80.93	13.18	80.88	13.53	80.82	13.89	82
83	81.98	12.98	81.92	13.34	81.86	13.70	81.80	14.06	83
84	82.97	13.14	82.91	13.50	82.85	13.86	82.79	14.23	84
85	83.95	13.30	83.89	13.66	83.83	14.03	83.77	14.39	85
86	84.94	13.45	84.88	13.82	84.82	14.19	84.76	14.56	86
87	85.93	13.61	85.87	13.98	85.81	14.36	85.74	14.73	87
88	86.92	13.77	86.86	14.15	86.79	14.52	86.73	14.90	88
89	87.90	13.92	87.84	14.31	87.78	14.69	87.71	15.07	89
90	88.89	14.08	88.83	14.47	88.77	14.85	88.70	15.24	90
91	89.88	14.24	89.82	14.63	89.75	15.02	89.69	15.41	91
92	90.87	14.39	90.80	14.79	90.74	15.18	90.67	15.58	92
93	91.86	14.55	91.79	14.95	91.72	15.35	91.66	15.75	93
94	92.84	14.70	92.78	15.11	92.71	15.51	92.64	15.92	94
95	93.83	14.86	93.76	15.27	93.70	15.68	93.63	16.09	95
96	94.82	15.02	94.75	15.43	94.68	15.84	94.61	16.26	96
97	95.81	15.17	95.74	15.59	95.67	16.01	95.60	16.43	97
98	96.79	15.33	96.73	15.75	96.66	16.17	96.58	16.60	98
99	97.78	15.49	97.71	15.91	97.64	16.34	97.57	16.77	99
100	98.77	15.64	98.70	16.07	98.63	16.50	98.56	16.93	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	81 Deg.		80¾ Deg.		80½ Deg.		80¼ Deg.		

Dist.	10 Deg.		10¼ Deg.		10½ Deg.		10¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.98	0.17	0.98	0.18	0.98	0.18	0.98	0.19	1
2	1.97	0.35	1.97	0.36	1.97	0.36	1.96	0.37	2
3	2.95	0.52	2.95	0.53	2.95	0.55	2.95	0.56	3
4	3.94	0.69	3.94	0.71	3.93	0.73	3.93	0.75	4
5	4.92	0.87	4.92	0.89	4.92	0.91	4.91	0.93	5
6	5.91	1.04	5.90	1.07	5.90	1.09	5.89	1.12	6
7	6.89	1.22	6.89	1.25	6.88	1.28	6.88	1.31	7
8	7.88	1.39	7.87	1.42	7.87	1.46	7.86	1.49	8
9	8.86	1.56	8.86	1.60	8.85	1.64	8.84	1.68	9
10	9.85	1.74	9.84	1.78	9.83	1.82	9.82	1.87	10
11	10.83	1.91	10.82	1.96	10.82	2.00	10.81	2.05	11
12	11.82	2.08	11.81	2.14	11.80	2.19	11.79	2.24	12
13	12.80	2.26	12.79	2.31	12.78	2.37	12.77	2.42	13
14	13.79	2.43	13.78	2.49	13.77	2.55	13.75	2.61	14
15	14.77	2.60	14.76	2.67	14.75	2.73	14.74	2.80	15
16	15.76	2.78	15.74	2.85	15.73	2.92	15.72	2.98	16
17	16.74	2.95	16.73	3.03	16.72	3.10	16.70	3.17	17
18	17.73	3.13	17.71	3.20	17.70	3.28	17.68	3.36	18
19	18.71	3.30	18.70	3.38	18.68	3.46	18.67	3.54	19
20	19.70	3.47	19.68	3.56	19.67	3.64	19.65	3.73	20
21	20.68	3.65	20.66	3.74	20.65	3.83	20.63	3.92	21
22	21.67	3.82	21.65	3.91	21.63	4.01	21.61	4.10	22
23	22.65	3.99	22.63	4.09	22.61	4.19	22.60	4.29	23
24	23.64	4.17	23.62	4.27	23.60	4.37	23.58	4.48	24
25	24.62	4.34	24.60	4.45	24.58	4.56	24.56	4.66	25
26	25.61	4.51	25.59	4.63	25.56	4.74	25.54	4.85	26
27	26.59	4.69	26.57	4.80	26.55	4.92	26.53	5.04	27
28	27.57	4.86	27.55	4.98	27.53	5.10	27.51	5.22	28
29	28.56	5.04	28.54	5.16	28.51	5.28	28.49	5.41	29
30	29.54	5.21	29.52	5.34	29.50	5.47	29.47	5.60	30
31	30.53	5.38	30.51	5.52	30.48	5.65	30.46	5.78	31
32	31.51	5.56	31.49	5.69	31.46	5.83	31.44	5.97	32
33	32.50	5.73	32.47	5.87	32.45	6.01	32.42	6.16	33
34	33.48	5.90	33.46	6.05	33.43	6.20	33.40	6.34	34
35	34.47	6.08	34.44	6.23	34.41	6.38	34.39	6.53	35
36	35.45	6.25	35.43	6.41	35.40	6.56	35.37	6.71	36
37	36.44	6.42	36.41	6.58	36.38	6.74	36.35	6.90	37
38	37.42	6.60	37.39	6.76	37.36	6.92	37.33	7.09	38
39	38.41	6.77	38.38	6.94	38.35	7.11	38.32	7.27	39
40	39.39	6.95	39.36	7.12	39.33	7.29	39.30	7.46	40
41	40.38	7.12	40.35	7.30	40.31	7.47	40.28	7.65	41
42	41.36	7.29	41.33	7.47	41.30	7.65	41.26	7.83	42
43	42.35	7.47	42.31	7.65	42.28	7.84	42.25	8.02	43
44	43.33	7.64	43.30	7.83	43.26	8.02	43.23	8.21	44
45	44.32	7.81	44.28	8.01	44.25	8.20	44.21	8.39	45
46	45.30	7.99	45.27	8.19	45.23	8.38	45.19	8.58	46
47	46.29	8.16	46.25	8.36	46.21	8.57	46.18	8.77	47
48	47.27	8.34	47.23	8.54	47.20	8.75	47.16	8.95	48
49	48.26	8.51	48.22	8.72	48.18	8.93	48.14	9.14	49
50	49.24	8.68	49.20	8.90	49.16	9.11	49.12	9.33	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	80 Deg.		79¾ Deg.		79½ Deg.		79¼ Deg.		

Diſt.	10 Deg.		10¼ Deg.		10½ Deg.		10¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50,23	8,86	50,19	9,08	50,15	9,29	50,10	9,51	51
52	51,21	9,03	51,17	9,25	51,13	9,48	51,09	9,70	52
53	52,19	9,20	52,15	9,43	52,11	9,66	52,07	9,89	53
54	53,18	9,38	53,14	9,61	53,10	9,84	53,05	10,07	54
55	54,16	9,55	54,12	9,79	54,08	10,02	54,03	10,26	55
56	55,15	9,72	55,11	9,96	55,06	10,21	55,02	10,45	56
57	56,13	9,90	56,09	10,14	56,05	10,39	56,00	10,63	57
58	57,12	10,07	57,07	10,32	57,03	10,57	56,98	10,82	58
59	58,10	10,25	58,06	10,50	58,01	10,75	57,96	11,00	59
60	59,09	10,42	59,04	10,68	59,00	10,93	58,95	11,19	60
61	60,07	10,59	60,03	10,85	59,98	11,12	59,93	11,38	61
62	61,06	10,77	61,01	11,03	60,96	11,30	60,91	11,56	62
63	62,04	10,94	61,99	11,21	61,95	11,48	61,89	11,75	63
64	63,03	11,11	62,98	11,39	62,93	11,66	62,88	11,94	64
65	64,01	11,29	63,96	11,57	63,91	11,85	63,86	12,12	65
66	65,00	11,46	64,95	11,74	64,89	12,03	64,84	12,31	66
67	65,98	11,63	65,93	11,92	65,88	12,21	65,82	12,50	67
68	66,97	11,81	66,91	12,10	66,86	12,39	66,81	12,68	68
69	67,95	11,98	67,90	12,28	67,84	12,57	67,79	12,87	69
70	68,94	12,16	68,88	12,46	68,83	12,76	68,77	13,06	70
71	69,92	12,33	69,87	12,63	69,81	12,94	69,75	13,24	71
72	70,91	12,50	70,85	12,81	70,79	13,12	70,74	13,43	72
73	71,89	12,68	71,83	12,99	71,78	13,30	71,72	13,62	73
74	72,88	12,85	72,82	13,17	72,76	13,49	72,70	13,80	74
75	73,86	13,02	73,80	13,35	73,74	13,67	73,68	13,99	75
76	74,85	13,20	74,79	13,52	74,73	13,85	74,67	14,18	76
77	75,83	13,37	75,77	13,70	75,71	14,03	75,65	14,36	77
78	76,82	13,54	76,76	13,88	76,69	14,21	76,63	14,55	78
79	77,80	13,72	77,74	14,06	77,68	14,40	77,61	14,74	79
80	78,78	13,89	78,72	14,24	78,66	14,58	78,60	14,92	80
81	79,77	14,07	79,71	14,41	79,64	14,76	79,58	15,11	81
82	80,75	14,24	80,69	14,59	80,63	14,94	80,56	15,29	82
83	81,74	14,41	81,68	14,77	81,61	15,13	81,54	15,48	83
84	82,72	14,59	82,66	14,95	82,59	15,31	82,53	15,67	84
85	83,71	14,76	83,64	15,13	83,58	15,49	83,51	15,85	85
86	84,69	14,93	84,63	15,30	84,56	15,67	84,49	16,04	86
87	85,68	15,11	85,61	15,48	85,54	15,85	85,47	16,23	87
88	86.66	15,28	86,60	15,66	86,53	16,04	86,46	16,41	88
89	87,65	15,45	87,58	15,84	87,51	16,22	87,44	16,60	89
90	88,63	15,63	88,56	16,01	88,49	16,40	88,42	16,79	90
91	89,62	15,80	89,55	16,19	89,48	16,58	89,40	16,97	91
92	90,60	15,98	90,53	16,37	90,46	16,77	90,39	17,16	92
93	91,59	16,15	91,52	16,55	91,44	16,95	91,37	17,35	93
94	92,57	16,32	92,50	16,73	92,43	17,13	92,35	17,53	94
95	93,56	16,50	93,48	16,90	93,41	17,31	93,33	17,72	95
96	94,54	16,67	94,47	17,08	94,39	17,49	94,32	17,91	96
97	95,53	16,84	95,45	17,26	95,38	17,68	95,30	18,09	97
98	96,51	17,02	96,44	17,44	96,36	17,86	96,28	18,28	98
99	97,50	17,19	97,42	17,62	97,34	18,04	97,26	18,47	99
100	98,48	17,36	98,40	17,79	98,33	18,22	98.25	18,65	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	80 Deg.		79¾ Deg.		79½ Deg.		79¼ Deg.		

Diſt.	12 Deg.		12¼ Deg.		12½ Deg.		12¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.98	0.21	0.98	0.21	0.98	0.22	0.98	0.22	1
2	1.96	0.42	1.95	0.42	1.95	0.43	1.95	0.44	2
3	2.93	0.62	2.93	0.64	2.93	0.65	2.93	0.66	3
4	3.91	0.83	3.91	0.85	3.91	0.87	3.90	0.88	4
5	4.89	1.04	4.89	1.06	4.88	1.08	4.88	1.10	5
6	5.87	1.25	5.86	1.27	5.86	1.30	5.85	1.32	6
7	6.85	1.46	6.84	1.49	6.83	1.52	6.83	1.54	7
8	7.83	1.66	7.82	1.70	7.81	1.73	7.80	1.77	8
9	8.80	1.87	8.80	1.91	8.79	1.95	8.78	1.99	9
10	9.78	2.08	9.77	2.12	9.76	2.16	9.75	2.21	10
11	10.76	2.29	10.75	2.33	10.74	2.38	10.73	2.43	11
12	11.74	2.49	11.73	2.55	11.72	2.60	11.70	2.65	12
13	12.72	2.70	12.70	2.76	12.69	2.81	12.68	2.87	13
14	13.69	2.91	13.68	2.97	13.67	3.03	13.65	3.09	14
15	14.67	3.12	14.66	3.18	14.64	3.25	14.63	3.31	15
16	15.65	3.33	15.64	3.39	15.62	3.46	15.61	3.53	16
17	16.63	3.53	16.61	3.61	16.60	3.68	16.58	3.75	17
18	17.61	3.74	17.59	3.82	17.57	3.90	17.56	3.97	18
19	18.58	3.95	18.57	4.03	18.55	4.11	18.53	4.19	19
20	19.56	4.16	19.54	4.24	19.53	4.33	19.51	4.41	20
21	20.54	4.37	20.52	4.46	20.50	4.55	20.48	4.63	21
22	21.52	4.57	21.50	4.67	21.48	4.76	21.46	4.86	22
23	22.50	4.78	22.48	4.88	22.45	4.98	22.43	5.08	23
24	23.48	4.99	23.45	5.09	23.43	5.19	23.41	5.30	24
25	24.45	5.20	24.43	5.30	24.41	5.41	24.38	5.52	25
26	25.43	5.41	25.41	5.52	25.38	5.63	25.36	5.74	26
27	26.41	5.61	26.39	5.73	26.36	5.84	26.33	5.96	27
28	27.39	5.82	27.36	5.94	27.34	6.06	27.31	6.18	28
29	28.37	6.03	28.34	6.15	28.31	6.28	28.28	6.40	29
30	29.34	6.24	29.32	6.37	29.29	6.49	29.26	6.62	30
31	30.32	6.45	30.29	6.58	30.27	6.71	30.24	6.84	31
32	31.30	6.65	31.27	6.79	31.24	6.93	31.21	7.06	32
33	32.28	6.86	32.25	7.00	32.22	7.14	32.19	7.28	33
34	33.26	7.07	33.23	7.21	33.19	7.36	33.16	7.50	34
35	34.24	7.28	34.20	7.43	34.17	7.58	34.14	7.72	35
36	35.21	7.48	35.18	7.64	35.15	7.79	35.11	7.95	36
37	36.19	7.69	36.16	7.85	36.12	8.01	36.09	8.17	37
38	37.17	7.90	37.13	8.06	37.10	8.22	37.06	8.39	38
39	38.15	8.11	38.11	8.27	38.08	8.44	38.04	8.61	39
40	39.13	8.32	39.09	8.49	39.05	8.66	39.01	8.83	40
41	40.10	8.52	40.07	8.70	40.03	8.87	39.99	9.05	41
42	41.08	8.73	41.04	8.91	41.00	9.09	40.96	9.27	42
43	42.06	8.94	42.02	9.12	41.98	9.31	41.94	9.49	43
44	43.04	9.15	43.00	9.34	42.96	9.52	42.92	9.71	44
45	44.02	9.36	43.98	9.55	43.93	9.74	43.89	9.93	45
46	44.99	9.56	44.95	9.76	44.91	9.96	44.87	10.15	46
47	45.97	9.77	45.93	9.97	45.89	10.17	45.84	10.37	47
48	46.95	9.98	46.91	10.18	46.86	10.39	46.82	10.59	48
49	47.93	10.19	47.88	10.40	47.84	10.61	47.79	10.81	49
50	48.91	10.40	48.86	10.61	48.81	10.82	48.77	10.03	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Diſt.	78 Deg.		77¾ Deg.		77½ Deg.		77¼ Deg.		Diſt.

Dist.	12 Deg.		12¼ Deg		12½ Deg.		12¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.89	10.60	49.84	10.82	49.79	11.04	49.74	11.26	51
52	50.86	10.81	50.82	11.03	50.77	11.25	50.72	11.48	52
53	51.84	11.02	51.79	11.25	51.74	11.47	51.69	11.70	53
54	52.82	11.23	52.77	11.46	52.72	11.69	52.67	11.92	54
55	53.80	11.44	53.75	11.67	53.70	11.90	53.64	12.14	55
56	54.78	11.64	54.72	11.88	54.67	12.12	54.62	12.36	56
57	55.75	11.85	55.70	12.09	55.65	12.34	55.59	12.58	57
58	56.73	12.06	56.68	12.31	56.63	12.55	56.57	12.80	58
59	57.71	12.27	57.66	12.52	57.60	12.77	57.55	13.02	59
60	58.69	12.47	58.63	12.73	58.58	12.99	58.52	13.24	60
61	59.67	12.68	59.61	12.94	59.55	13.20	59.50	13.46	61
62	60.65	12.89	60.59	13.16	60.53	13.42	60.47	13.68	62
63	61.62	13.10	61.57	13.37	61.51	13.64	61.45	13.90	63
64	62.60	13.31	62.54	13.58	62.48	13.85	62.42	14.12	64
65	63.58	13.51	63.52	13.79	63.46	14.07	63.40	14.35	65
66	64.56	13.72	64.50	14.00	64.44	14.29	64.37	14.57	66
67	65.54	13.93	65.47	14.22	65.41	14.50	65.35	14.79	67
68	66.51	14.14	66.45	14.43	66.39	14.72	66.32	15.01	68
69	67.49	14.35	67.43	14.64	67.36	14.93	67.30	15.23	69
70	68.47	14.55	68.41	14.85	68.34	15.15	68.27	15.45	70
71	69.45	14.76	69.38	15.06	69.32	15.37	69.25	15.67	71
72	70.43	14.97	70.36	15.28	70.29	15.58	70.22	15.89	72
73	71.40	15.18	71.34	15.49	71.27	15.80	71.20	16.11	73
74	72.38	15.39	72.32	15.70	72.25	16.02	72.18	16.33	74
75	73.36	15.59	73.29	15.91	73.22	16.23	73.15	16.55	75
76	74.34	15.80	74.27	16.13	74.20	16.45	74.13	16.77	76
77	75.32	16.01	75.25	16.34	75.17	16.67	75.10	16.99	77
78	76.30	16.22	76.22	16.55	76.15	16.88	76.08	17.21	78
79	77.27	16.43	77.20	16.76	77.13	17.10	77.05	17.44	79
80	78.25	16.63	78.18	16.97	78.10	17.32	78.03	17.66	80
81	79.23	16.84	79.16	17.19	79.08	17.53	79.00	17.88	81
82	80.21	17.05	80.13	17.40	80.06	17.75	79.98	18.10	82
83	81.19	17.26	81.11	17.61	81.03	17.96	80.95	18.32	83
84	82.16	17.46	82.09	17.82	82.01	18.18	81.93	18.54	84
85	83.14	17.67	83.06	18.04	82.99	18.40	82.90	18.76	85
86	84.12	17.88	84.04	18.25	83.96	18.61	83.88	18.98	86
87	85.10	18.09	85.02	18.46	84.94	18.83	84.85	19.20	87
88	86.08	18.30	86.00	18.67	85.91	19.05	85.83	19.42	88
89	87.06	18.50	86.97	18.88	86.89	19.26	86.81	19.64	89
90	88.03	18.71	87.95	19.10	87.87	19.48	87.78	19.86	90
91	89.01	18.92	88.93	19.31	88.84	19.70	88.76	20.08	91
92	89.99	19.13	89.91	19.52	89.82	19.91	89.73	20.30	92
93	90.97	19.34	90.88	19.73	90.80	20.13	90.71	20.52	93
94	91.95	19.54	91.86	19.94	91.77	20.35	91.68	20.75	94
95	92.92	19.75	92.84	20.16	92.75	20.56	92.66	20.97	95
96	93.90	19.96	93.81	20.37	93.72	20.78	93.63	21.19	96
97	94.88	20.17	94.79	20.58	94.70	20.99	94.61	21.41	97
98	95.86	20.38	95.77	20.79	95.68	21.21	95.58	21.63	98
99	96.84	20.58	96.75	21.01	96.65	21.43	96.56	21.85	99
100	97.81	20.79	97.72	21.22	97.63	21.64	97.53	22.07	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	78 Deg.		77¾ Deg.		77½ Deg.		77¼ Deg.		Dist.

Dist.	13 Deg.		13¼ Deg.		13½ Deg.		13¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,97	0,23	0,97	0,23	0,97	0,23	0,97	0,24	1
2	1,95	0,45	1,95	0,46	1,95	0,47	1,94	0,48	2
3	2,92	0,67	2,92	0,69	2,92	0,70	2,91	0,71	3
4	3,90	0,90	3,89	0,92	3,89	0,93	3,89	0,95	4
5	4,87	1,12	4,87	1,15	4,86	1,17	4,86	1,19	5
6	5,85	1,35	5,84	1,38	5,83	1,40	5,83	1,43	6
7	6,82	1,57	6,81	1,60	6,81	1,63	6,80	1,66	7
8	7,80	1,80	7,79	1,83	7,78	1,87	7,77	1,90	8
9	8,77	2,02	8,76	2,06	8,75	2,10	8,74	2,14	9
10	9,74	2,25	9,73	2,29	9,72	2,33	9,71	2,38	10
11	10,72	2,47	10,71	2,52	10,70	2,57	10,68	2,61	11
12	11,69	2,70	11,68	2,75	11,67	2,80	11,66	2,85	12
13	12,67	2,92	12,65	2,98	12,64	3,03	12,63	3,09	13
14	13,64	3,15	13,63	3,21	13,61	3,27	13,60	3,33	14
15	14,62	3,37	14,60	3,44	14,59	3,50	14,57	3,57	15
16	15,59	3,60	15,57	3,67	15,56	3,74	15,54	3,80	16
17	16,57	3,82	16,55	3,90	16,53	3,97	16,51	4,04	17
18	17,54	4,05	17,52	4,13	17,50	4,20	17,48	4,28	18
19	18,51	4,27	18,49	4,35	18,46	4,44	18,46	4,52	19
20	19,49	4,50	19,47	4,58	19,45	4,67	19,43	4,75	20
21	20,46	4,72	20,44	4,81	20,42	4,90	20,40	4,99	21
22	21,44	4,95	21,41	5,04	21,39	5,14	21,37	5,23	22
23	22,41	5,17	22,39	5,27	22,36	5,37	22,34	5,47	23
24	23,38	5,40	23,36	5,50	23,34	5,60	23,31	5,70	24
25	24,36	5,62	24,33	5,73	24,31	5,84	24,28	5,94	25
26	25,33	5,85	25,31	5,96	25,28	6,07	25,25	6,18	26
27	26,31	6,07	26,28	6,19	26,25	6,30	26,23	6,42	27
28	27,28	6,30	27,25	6,42	27,23	6,54	27.20	6,66	28
29	28,26	6,52	28,23	6,65	28,20	6,77	28,17	6,89	29
30	29,23	6,75	29,20	6,88	29,17	7,00	29,14	7,13	30
31	30,21	6,97	30,17	7,11	30,14	7,24	30,11	7,37	31
32	31,18	7,20	31,15	7,33	31,12	7,47	31,08	7,61	32
33	32,15	7,42	32,12	7,56	32,09	7,70	32,05	7,84	33
34	33,13	7,65	33,09	7,79	33,06	7,94	33,03	8,08	34
35	34,10	7,87	34,07	8,02	34,03	8,17	34,00	8,32	35
36	35,08	8,10	35.04	8,25	35,01	8,40	34,97	8,56	36
37	36,05	8,32	36,02	8,48	35,98	8,64	35,94	8,79	37
38	37,03	8,55	30,99	8,71	36,95	8,87	36,91	9,03	38
39	38,00	8,77	37,96	8,94	37,92	9,10	37,88	9,27	39
40	38,97	9,00	38,94	9,17	38,89	9,34	38,85	9,51	40
41	39,95	9,22	39,91	9,40	39,87	9,57	39,83	9,75	41
42	40,92	9,45	40,88	9,63	40,84	9,80	40,80	9,98	42
43	41,90	9,67	41,86	9,86	41,81	10,04	41,77	10,22	43
44	42,87	9,90	42,83	10,08	42,78	10,27	42,74	10,46	44
45	43,85	10,12	43,80	10,31	43,76	10,51	43,71	10,70	45
46	44,82	10,35	44.78	10,54	44,73	10,74	44,68	10,93	46
47	45,80	10,57	45,75	10,77	45,70	10,97	45,65	11,17	47
48	46,77	10,90	46,72	11,00	46,07	11,21	46,62	11,41	48
49	47,74	11,02	47,70	11,23	47,65	11,44	47,60	11,65	49
50	48,72	11,25	48,67	11,46	48,62	11,67	48,57	11,88	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	77 Deg.		76¾ Deg.		76½ Deg.		76¼ Deg.		

Diſt.	13 Deg.		13¼ Deg.		13½ Deg.		13¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.69	11.47	49.64	11.69	49.59	11.91	49.54	12.12	51
52	50.67	11.70	50.62	11.92	50.56	12.14	50.51	12.36	52
53	51.64	11.92	51.59	12.15	51.54	12.37	51.48	12.60	53
54	52.62	12.15	52.56	12.38	52.51	12.61	52.45	12.84	54
55	53.59	12.37	53.54	12.61	53.48	12.84	53.42	13.07	55
56	54.56	12.60	54.51	12.84	54.45	13.07	54.40	13.31	56
57	55.54	12.82	55.48	13.06	55.43	13.31	55.37	13.55	57
58	56.5[illegible]	13.05	56.46	13.29	56.40	13.54	56.34	13.79	58
59	57.49	13.27	57.43	13.52	57.37	13.77	57.31	14.02	59
60	58.46	13.50	58.40	13.75	58.34	14.01	58.28	14.26	60
61	59.44	13.72	59.38	13.98	59.31	14.24	59.25	14.50	61
62	60.41	13.95	60.35	14.21	60.29	14.47	60.22	14.74	62
63	61.39	14.17	61.32	14.44	61.26	14.71	61.19	14.97	63
64	62.36	14.40	62.30	14.67	62.23	14.94	62.17	15.21	64
65	63.33	14.62	63.27	14.90	63.20	15.17	63.14	15.45	65
66	64.31	14.85	64.24	15.13	64.18	15.41	64.11	15.69	66
67	65.28	15.07	65.22	15.36	65.15	15.64	65.08	15.93	67
68	66.26	15.30	66.19	15.59	66.12	15.87	66.05	16.16	68
69	67.23	15.52	67.16	15.81	67.09	16.11	67.02	16.40	69
70	68.21	15.75	68.14	16.04	68.07	16.34	67.99	16.64	70
71	69.18	15.97	69.11	16.27	69.04	16.57	68.97	16.88	71
72	70.15	16.20	70.08	16.50	70.01	16.81	69.94	17.11	72
73	71.13	16.42	71.06	16.73	70.98	17.04	70.91	17.35	73
74	72.10	16.65	72.03	16.96	71.96	17.28	71.88	17.59	74
75	73.08	16.87	73.00	17.19	72.93	17.50	72.85	17.83	75
76	74.05	17.10	73.98	17.42	73.90	17.74	73.82	18.06	76
77	75.03	17.32	74.95	17.65	74.87	17.98	74.79	18.30	77
78	76.00	17.55	75.92	17.88	75.84	18.21	75.76	18.54	78
79	76.98	17.77	76.90	18.11	76.82	18.44	76.74	18.78	79
80	77.95	18.00	77.87	18.34	77.79	18.68	77.71	19.01	80
81	78.92	18.22	78.84	18.57	78.76	18.91	78.68	19.25	81
82	79.90	18.45	79.82	18.79	79.73	19.14	79.65	19.49	82
83	80.87	18.67	80.79	19.02	80.71	19.38	80.62	19.73	83
84	81.85	18.90	81.76	19.25	81.68	19.61	81.59	19.97	84
85	82.82	19.12	82.74	19.48	82.65	19.84	82.56	20.20	85
86	83.80	19.35	83.71	19.71	83.62	20.08	83.54	20.44	86
87	84.77	19.57	84.68	19.94	84.60	20.31	84.51	20.68	87
88	85.74	19.80	85.66	20.17	85.57	20.54	85.48	20.92	88
89	86.72	20.02	86.63	20.40	86.54	20.78	86.45	21.15	89
90	87.69	20.25	87.60	20.63	87.51	21.01	87.42	21.39	90
91	88.67	20.47	88.58	20.86	88.49	21.24	88.39	21.63	91
92	89.64	20.70	89.55	21.09	89.46	21.48	89.36	21.87	92
93	90.62	20.92	90.52	21.32	90.43	21.71	90.33	22.10	93
94	91.59	21.15	91.50	21.54	91.40	21.94	91.31	22.34	94
95	92.57	21.37	92.47	21.77	92.38	22.18	92.28	22.58	95
96	93.54	21.60	93.44	22.00	93.35	22.41	93.25	22.82	96
97	94.51	21.82	94.42	22.23	94.32	22.64	94.22	23.06	97
98	95.49	22.05	95.39	22.46	95.29	22.88	95.19	23.29	98
99	96.46	22.27	96.36	22.69	96.26	23.11	96.16	23.53	99
100	97.44	22.50	97.34	22.92	97.24	23.34	97.13	23.77	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	77 Deg.		76¾ Deg.		76½ Deg.		76¼ Deg.		

Diſt.	14 Deg.		14¼ Deg.		14½ Deg.		14¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.97	0.24	0.97	0.25	0.97	0.25	0.97	0.25	1
2	1.94	0.48	1.94	0.49	1.94	0.50	1.93	0.51	2
3	2.91	0.73	2.91	0.74	2.90	0.75	2.90	0.76	3
4	3.88	0.97	3.88	0.98	3.87	1.00	3.87	1.02	4
5	4.85	1.21	4.85	1.23	4.84	1.25	4.84	1.27	5
6	5.82	1.45	5.82	1.48	5.81	1.50	5.80	1.53	6
7	6.79	1.69	6.78	1.72	6.78	1.75	6.77	1.78	7
8	7.76	1.94	7.75	1.97	7.75	2.00	7.74	2.04	8
9	8.73	2.18	8.72	2.22	8.71	2.25	8.70	2.29	9
10	9.70	2.42	9.69	2.46	9.68	2.50	9.67	2.55	10
11	10.67	2.66	10.66	2.71	10.65	2.75	10.64	2.80	11
12	11.64	2.90	11.63	2.95	11.62	3.00	11.60	3.06	12
13	12.61	3.15	12.60	3.20	12.59	3.25	12.57	3.31	13
14	13.58	3.39	13.57	3.45	13.55	3.51	13.54	3.56	14
15	14.55	3.63	14.54	3.69	14.52	3.76	14.51	3.82	15
16	15.52	3.87	15.51	3.94	15.49	4.01	15.47	4.07	16
17	16.50	4.11	16.48	4.18	16.46	4.26	16.44	4.33	17
18	17.47	4.35	17.45	4.43	17.43	4.51	17.41	4.58	18
19	18.44	4.60	18.42	4.68	18.39	4.76	18.37	4.84	19
20	19.41	4.84	19.38	4.92	19.36	5.01	19.34	5.09	20
21	20.38	5.08	20.35	5.17	20.33	5.26	20.31	5.35	21
22	21.35	5.32	21.32	5.42	21.30	5.51	21.28	5.60	22
23	22.32	5.56	22.29	5.66	22.27	5.76	22.24	5.86	23
24	23.29	5.81	23.26	5.91	23.24	6.01	23.21	6.11	24
25	24.26	6.05	24.23	6.15	24.20	6.26	24.18	6.37	25
26	25.23	6.29	25.20	6.40	25.17	6.51	25.14	6.62	26
27	26.20	6.53	26.17	6.65	26.14	6.76	26.11	6.87	27
28	27.17	6.77	27.14	6.89	27.11	7.01	27.08	7.13	28
29	28.14	7.02	28.11	7.14	28.08	7.26	28.04	7.38	29
30	29.11	7.26	29.08	7.38	29.04	7.51	29.01	7.64	30
31	30.08	7.50	30.05	7.63	30.01	7.76	29.98	7.89	31
32	31.05	7.74	31.02	7.88	30.98	8.01	30.95	8.15	32
33	32.02	7.98	31.98	8.12	31.95	8.26	31.91	8.40	33
34	32.99	8.23	32.95	8.37	32.92	8.51	32.88	8.66	34
35	33.96	8.47	33.92	8.62	33.89	8.76	33.85	8.91	35
36	34.93	8.71	34.89	8.86	34.85	9.01	34.81	9.17	36
37	35.90	8.95	35.86	9.11	35.82	9.26	35.78	9.42	37
38	36.87	9.19	36.83	9.35	36.79	9.51	36.75	9.67	38
39	37.84	9.44	37.80	9.60	37.76	9.76	37.71	9.93	39
40	38.81	9.68	38.77	9.85	38.73	10.02	38.68	10.18	40
41	39.78	9.92	39.74	10.09	39.69	10.27	39.65	10.44	41
42	40.75	10.16	40.71	10.34	40.66	10.52	40.62	10.69	42
43	41.72	10.40	41.08	10.58	41.63	10.77	41.58	10.95	43
44	42.69	10.64	42.65	10.83	42.60	11.02	42.55	11.20	44
45	43.66	10.89	43.62	11.08	43.57	11.27	43.52	11.46	45
46	44.63	11.13	44.58	11.32	44.53	11.52	44.48	11.71	46
47	45.60	11.37	45.55	11.57	45.50	11.77	45.45	11.97	47
48	46.57	11.61	40.52	11.82	40.47	12.02	46.42	12.22	48
49	47.54	11.85	47.49	12.06	47.44	12.27	47.39	12.48	49
50	48.51	12.10	48.40	12.31	48.41	12.52	48.35	12.73	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	76 Deg.		75¾ Deg.		75½ Deg.		75¼ Deg.		

Dist.	14 Deg.		14¼ Deg.		14½ Deg.		14¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.49	12.34	49.43	12.55	49.38	12.77	49.32	12.98	51
52	50.46	12.58	50.40	12.80	50.34	13.02	50.29	13.24	52
53	51.43	12.82	51.37	13.05	51.31	13.27	51.25	13.49	53
54	52.40	13.06	52.34	13.29	52.28	13.52	52.22	13.75	54
55	53.37	13.31	53.31	13.54	53.25	13.77	53.19	14.00	55
56	54.34	13.55	54.28	13.78	54.22	14.02	54.15	14.26	56
57	55.31	13.79	55.25	14.03	55.18	14.27	55.12	14.51	57
58	56.28	14.03	56.22	14.28	56.15	14.52	56.09	14.77	58
59	57.25	14.27	57.18	14.52	57.12	14.77	57.06	15.02	59
60	58.22	14.52	58.15	14.77	58.09	15.02	58.02	15.28	60
61	59.19	14.76	59.12	15.02	59.06	15.27	58.99	15.53	61
62	60.16	15.00	60.09	15.26	60.03	15.52	59.96	15.79	62
63	61.13	15.24	61.06	15.51	60.99	15.77	60.92	16.04	63
64	62.10	15.48	62.03	15.75	61.96	16.02	61.89	16.29	64
65	63.07	15.72	63.00	16.00	62.93	16.27	62.86	16.55	65
66	64.04	15.97	63.97	16.25	63.90	16.53	63.83	16.80	66
67	65.01	16.21	64.94	16.49	64.87	16.78	64.79	17.05	67
68	65.98	16.45	65.91	16.74	65.83	17.03	65.76	17.31	68
69	66.95	16.69	66.88	16.98	66.80	17.28	66.73	17.57	69
70	67.92	16.93	67.85	17.23	67.77	17.53	67.69	17.82	70
71	68.89	17.18	68.82	17.48	68.74	17.78	68.66	18.08	71
72	69.86	17.42	69.78	17.72	69.71	18.03	69.63	18.33	72
73	70.83	17.66	70.75	17.97	70.67	18.28	70.59	18.59	73
74	71.80	17.90	71.72	18.22	71.64	18.53	71.56	18.84	74
75	72.77	18.14	72.69	18.46	72.61	18.78	72.53	19.10	75
76	73.74	18.39	73.66	18.71	73.58	19.03	73.50	19.35	76
77	74.71	18.63	74.63	18.95	74.55	19.28	74.46	19.60	77
78	75.68	18.87	75.60	19.20	75.52	19.53	75.43	19.86	78
79	76.65	19.11	76.57	19.45	76.48	19.78	76.40	20.11	79
80	77.62	19.35	77.54	19.69	77.45	20.03	77.36	20.37	80
81	78.59	19.60	78.51	19.94	78.42	20.28	78.33	20.62	81
82	79.56	19.84	79.48	20.18	79.39	20.53	79.30	20.88	82
83	80.53	20.08	80.45	20.43	80.36	20.78	80.27	21.13	83
84	81.50	20.32	81.42	20.68	81.32	21.03	81.23	21.39	84
85	82.48	20.56	82.38	20.92	82.29	21.28	82.20	21.64	85
86	83.45	20.81	83.35	21.17	83.26	21.53	83.17	21.90	86
87	84.42	21.05	84.32	21.42	84.23	21.78	84.13	22.15	87
88	85.39	21.29	85.29	21.66	85.20	22.03	85.10	22.41	88
89	86.36	21.53	86.26	21.91	86.17	22.28	86.07	22.66	89
90	87.33	21.77	87.23	22.15	87.13	22.53	87.03	22.91	90
91	88.30	22.01	88.20	22.40	88.10	22.78	88.00	23.17	91
92	89.27	22.26	89.17	22.65	89.07	23.04	89.97	23.42	92
93	90.24	22.50	90.14	22.89	90.04	23.29	90.94	23.68	93
94	91.21	22.74	91.11	23.14	91.01	23.54	91.90	23.93	94
95	92.18	22.98	92.08	23.38	91.97	23.79	92.87	24.19	95
96	93.15	23.22	93.05	23.63	92.94	24.04	93.84	24.44	96
97	94.12	23.47	94.02	23.88	93.91	24.29	94.80	24.70	97
98	95.09	23.71	95.98	24.12	94.88	24.54	95.77	24.95	98
99	96.06	23.95	96.95	24.37	95.85	24.79	96.74	25.21	99
100	97.03	24.19	97.92	24.62	96.81	25.04	97.70	25.46	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	76 Deg.		75¾ Deg.		75½ Deg.		75¼ Deg.		

Diſt.	15 Deg.		15¼ Deg.		15½ Deg.		15¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.97	0.26	0.96	0.26	0.96	0.27	0.96	0.27	1
2	1.93	0.52	1.93	0.53	1.93	0.53	1.92	0.54	2
3	2.90	0.78	2.89	0.79	2.89	0.80	2.89	0.81	3
4	3.86	1.04	3.86	1.05	3.85	1.07	3.85	1.09	4
5	4.83	1.29	4.82	1.32	4.82	1.34	4.81	1.36	5
6	5.80	1.55	5.79	1.58	5.78	1.60	5.77	1.63	6
7	6.76	1.81	6.75	1.84	6.75	1.87	6.74	1.90	7
8	7.73	2.07	7.72	2.10	7.71	2.14	7.70	2.17	8
9	8.69	2.33	8.68	2.37	8.67	2.41	8.66	2.44	9
10	9.66	2.59	9.65	2.63	9.64	2.67	9.62	2.71	10
11	10.63	2.85	10.61	2.89	10.60	2.94	10.59	2.99	11
12	11.59	3.11	11.58	3.16	11.56	3.21	11.55	3.26	12
13	12.56	3.36	12.54	3.42	12.53	3.47	12.51	3.53	13
14	13.52	3.62	13.51	3.68	13.49	3.74	13.47	3.80	14
15	14.49	3.88	14.47	3.95	14.45	4.01	14.44	4.07	15
16	15.45	4.14	15.44	4.21	15.42	4.28	15.40	4.34	16
17	16.42	4.40	16.40	4.47	16.38	4.54	16.36	4.61	17
18	17.39	4.66	17.37	4.73	17.35	4.81	17.32	4.89	18
19	18.35	4.92	18.33	5.00	18.31	5.08	18.29	5.16	19
20	19.32	5.18	19.30	5.26	19.27	5.34	19.25	5.43	20
21	20.28	5.44	20.26	5.52	20.24	5.61	20.21	5.70	21
22	21.25	5.69	21.23	5.79	21.20	5.88	21.17	5.97	22
23	22.22	5.95	22.19	6.05	22.16	6.15	22.14	6.24	23
24	23.18	6.21	23.15	6.31	23.13	6.41	23.10	6.51	24
25	24.15	6.47	24.12	6.58	24.09	6.68	24.06	6.79	25
26	25.11	6.73	25.08	6.84	25.05	6.95	25.02	7.06	26
27	26.08	6.99	26.05	7.10	26.02	7.22	25.99	7.33	27
28	27.05	7.25	27.01	7.36	26.98	7.48	26.95	7.60	28
29	28.01	7.51	27.98	7.63	27.95	7.75	27.91	7.87	29
30	28.98	7.76	28.94	7.89	28.91	8.02	28.87	8.14	30
31	29.94	8.02	29.91	8.15	29.87	8.28	29.84	8.41	31
32	30.91	8.28	30.87	8.42	30.84	8.55	30.80	8.69	32
33	31.88	8.54	31.84	8.68	31.80	8.82	31.76	8.96	33
34	32.84	8.80	32.80	8.94	32.76	9.09	32.72	9.23	34
35	33.81	9.06	33.77	9.21	33.73	9.35	33.69	9.50	35
36	34.77	9.32	34.73	9.47	34.69	9.62	34.65	9.77	36
37	35.74	9.58	35.70	9.73	35.65	9.89	35.61	10.04	37
38	36.71	9.84	36.66	10.00	36.62	10.16	36.57	10.31	38
39	37.67	10.09	37.63	10.26	37.58	10.42	37.54	10.59	39
40	38.64	10.35	38.59	10.52	38.55	10.69	38.50	10.86	40
41	39.60	10.61	39.56	10.78	39.51	10.96	39.46	11.13	41
42	40.57	10.87	40.52	11.05	40.47	11.22	40.42	11.40	42
43	41.53	11.13	41.49	11.31	41.44	11.49	41.39	11.67	43
44	42.50	11.39	42.45	11.57	42.40	11.76	42.35	11.94	44
45	43.47	11.65	43.42	11.84	43.36	12.03	43.31	12.21	45
46	44.43	11.91	44.38	12.10	44.33	12.29	44.27	12.49	46
47	45.40	12.16	45.35	12.36	45.29	12.56	45.24	12.76	47
48	46.36	12.42	46.31	12.63	46.25	12.83	46.20	13.03	48
49	47.33	12.68	47.27	12.89	47.22	13.09	47.16	13.30	49
50	48.30	12.94	48.24	13.15	48.18	13.36	48.12	13.57	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	75 Deg.		74¾ Deg.		74½ Deg.		74¼ Deg.		

Diſt.	15 Deg.		15¼ Deg.		15½ Deg.		15¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.26	13.20	49.20	13.41	49.15	13.63	49.09	13.84	51
52	50.23	13.46	50.17	13.68	50.11	13.90	50.05	14.11	52
53	51.19	13.72	51.13	13.94	51.07	14.16	51.01	14.39	53
54	52.16	13.98	52.10	14.20	52.04	14.43	51.97	14.66	54
55	53.13	14.24	53.06	14.47	53.00	14.70	52.94	14.93	55
56	54.09	14.49	54.03	14.73	53.96	14.97	53.90	15.20	56
57	55.06	14.75	54.99	14.99	54.93	15.23	54.86	15.47	57
58	56.02	15.01	55.96	15.26	55.89	15.50	55.82	15.74	58
59	56.99	15.27	56.92	15.52	56.85	15.77	56.78	16.01	59
60	57.96	15.53	57.89	15.78	57.82	16.03	57.75	16.29	60
61	58.92	15.79	58.85	16.04	58.78	16.30	58.71	16.56	61
62	59.89	16.05	59.82	16.31	59.75	16.57	59.67	16.83	62
63	60.85	16.31	60.78	16.57	60.71	16.84	60.63	17.10	63
64	61.82	16.56	61.75	16.83	61.67	17.10	61.60	17.37	64
65	62.79	16.82	62.71	17.10	62.64	17.37	62.56	17.64	65
66	63.75	17.08	63.68	17.36	63.60	17.64	63.52	17.92	66
67	64.72	17.34	64.64	17.62	64.56	17.90	64.48	18.19	67
68	65.68	17.60	65.61	17.89	65.53	18.17	65.45	18.46	68
69	66.65	17.86	66.57	18.15	66.49	18.44	66.41	18.73	69
70	67.61	18.12	67.54	18.41	67.45	18.71	67.37	19.00	70
71	68.58	18.38	68.50	18.68	68.42	18.97	68.33	19.27	71
72	69.55	18.63	69.46	18.94	69.38	19.24	69.30	19.54	72
73	70.51	18.89	70.43	19.20	70.35	19.51	70.26	19.82	73
74	71.48	19.15	71.39	19.46	71.31	19.78	71.22	20.09	74
75	72.44	19.41	72.36	19.73	72.27	20.04	72.18	20.36	75
76	73.41	19.67	73.32	19.99	73.24	20.31	73.15	20.63	76
77	74.38	19.93	74.29	20.25	74.20	20.58	74.11	20.90	77
78	75.34	20.19	75.25	20.52	75.16	20.84	75.07	21.17	78
79	76.31	20.45	76.22	20.78	76.13	21.11	76.03	21.44	79
80	77.27	20.71	77.18	21.04	77.09	21.38	77.00	21.72	80
81	78.24	20.96	78.15	21.31	78.05	21.65	77.96	21.99	81
82	79.21	21.22	79.11	21.57	79.02	21.91	78.92	22.26	82
83	80.17	21.48	80.08	21.83	79.98	22.18	79.88	22.53	83
84	81.14	21.74	81.04	22.09	80.94	22.45	80.85	22.80	84
85	82.10	22.00	82.01	22.36	81.91	22.72	81.81	23.07	85
86	83.07	22.26	82.97	22.62	82.87	22.98	82.77	23.34	86
87	84.04	22.52	83.94	22.88	83.84	23.25	83.73	23.62	87
88	85.00	22.78	84.90	23.15	84.80	23.52	84.70	23.89	88
89	85.97	23.03	85.87	23.41	85.76	23.78	85.66	24.16	89
90	86.93	23.29	86.83	23.67	86.73	24.05	86.62	24.43	90
91	87.90	23.55	87.80	23.94	87.69	24.32	87.58	24.70	91
92	88.87	23.81	88.76	24.20	88.65	24.59	88.55	24.97	92
93	89.83	24.07	89.73	24.46	89.62	24.85	89.51	25.24	93
94	90.80	24.33	90.69	24.72	90.58	25.12	90.47	25.52	94
95	91.76	24.59	91.65	24.99	91.54	25.39	91.43	25.79	95
96	92.73	24.85	92.62	25.25	92.51	25.65	92.40	26.06	96
97	93.69	25.11	93.58	25.51	93.47	25.92	93.36	26.33	97
98	94.66	25.36	94.55	25.78	94.44	26.19	94.32	26.60	98
99	95.63	25.62	95.51	26.04	95.40	26.46	95.28	26.87	99
100	96.59	25.88	96.48	26.30	96.36	26.72	96.25	27.14	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	75 Deg.		74¾ Deg.		74½ Deg.		74¼ Deg.		

Dist.	16 Deg.		16¼ Deg.		16½ Deg.		16¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.96	0.28	0.96	0.28	0.96	0.28	0.96	0.29	1
2	1.92	0.55	1.92	0.56	1.92	0.57	1.92	0.58	2
3	2.88	0.83	2.88	0.84	2.88	0.85	2.87	0.86	3
4	3.85	1.10	3.84	1.12	3.84	1.14	3.83	1.15	4
5	4.81	1.38	4.80	1.40	4.79	1.42	4.79	1.44	5
6	5.77	1.65	5.76	1.68	5.75	1.70	5.75	1.73	6
7	6.73	1.93	6.72	1.96	6.71	1.99	6.70	2.02	7
8	7.69	2.21	7.68	2.24	7.67	2.27	7.66	2.31	8
9	8.65	2.48	8.64	2.52	8.63	2.56	8.62	2.59	9
10	9.61	2.76	9.60	2.80	9.59	2.84	9.58	2.88	10
11	10.57	3.03	10.56	3.08	10.55	3.12	10.53	3.17	11
12	11.54	3.31	11.52	3.36	11.51	3.41	11.49	3.46	12
13	12.50	3.58	12.48	3.64	12.46	3.69	12.45	3.75	13
14	13.46	3.86	13.44	3.92	13.42	3.98	13.41	4.03	14
15	14.42	4.13	14.40	4.20	14.38	4.26	14.36	4.32	15
16	15.38	4.41	15.36	4.48	15.34	4.54	15.32	4.61	16
17	16.34	4.69	16.32	4.76	16.30	4.83	16.28	4.90	17
18	17.30	4.96	17.28	5.04	17.26	5.11	17.24	5.19	18
19	18.26	5.24	18.24	5.32	18.22	5.40	18.19	5.48	19
20	19.23	5.51	19.20	5.60	19.18	5.68	19.15	5.76	20
21	20.19	5.79	20.16	5.88	20.14	5.96	20.11	6.05	21
22	21.15	6.06	21.12	6.16	21.09	6.25	21.07	6.34	22
23	22.11	6.34	22.08	6.44	22.05	6.53	22.02	6.63	23
24	23.07	6.62	23.04	6.72	23.01	6.82	22.98	6.92	24
25	24.03	6.89	24.00	7.00	23.97	7.10	23.94	7.20	25
26	24.99	7.17	24.96	7.28	24.93	7.38	24.90	7.49	26
27	25.95	7.44	25.92	7.56	25.89	7.67	25.85	7.78	27
28	26.92	7.72	26.88	7.84	26.85	7.95	26.81	8.07	28
29	27.88	7.99	27.84	8.11	27.81	8.24	27.77	8.36	29
30	28.84	8.27	28.80	8.39	28.76	8.52	28.73	8.65	30
31	29.80	8.54	29.76	8.67	29.72	8.80	29.68	8.93	31
32	30.76	8.82	30.72	8.95	30.68	9.09	30.64	9.22	32
33	31.72	9.10	31.68	9.23	31.64	9.37	31.60	9.51	33
34	32.68	9.37	32.64	9.51	32.60	9.66	32.56	9.80	34
35	33.64	9.65	33.60	0.79	33.56	9.94	33.51	10.09	35
36	34.61	9.92	34.56	10.07	34.52	10.22	34.47	10.38	36
37	35.57	10.20	35.52	10.35	35.48	10.51	35.43	10.66	37
38	36.53	10.47	36.48	10.63	36.44	10.79	36.39	10.95	38
39	37.49	10.75	37.44	10.91	37.39	11.08	37.35	11.24	39
40	38.45	11.03	38.40	11.19	38.35	11.36	38.30	11.53	40
41	39.41	11.30	39.36	11.47	39.31	11.64	39.26	11.82	41
42	40.37	11.58	40.32	11.75	40.27	11.93	40.22	12.10	42
43	41.33	11.85	41.28	12.03	41.23	12.21	41.18	12.39	43
44	42.30	12.13	42.24	12.31	42.19	12.50	42.13	12.68	44
45	43.26	12.40	43.20	12.59	43.15	12.78	43.09	12.97	45
46	44.22	12.68	44.16	12.87	44.11	13.06	44.05	13.26	46
47	45.18	12.95	45.12	13.15	45.06	13.35	45.01	13.55	47
48	46.14	13.23	46.08	13.43	46.02	13.63	45.96	13.83	48
49	47.10	13.51	47.04	13.71	46.98	13.92	46.92	14.12	49
50	48.06	13.78	48.00	13.99	47.94	14.20	47.88	14.41	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	74 Deg.		73¾ Deg.		73½ Deg.		73¼ Deg.		

Dist.	16 Deg.		16¼ Deg.		16½ Deg.		16¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.02	14.06	48.96	14.27	48.90	14.48	48.84	14.70	51
52	49.99	14.33	49.92	14.55	49.86	14.77	49.79	14.99	52
53	50.95	14.61	50.88	14.83	50.82	15.05	50.75	15.27	53
54	51.91	14.88	51.84	15.11	51.78	15.34	51.71	15.56	54
55	52.87	15.16	52.80	15.39	52.74	15.62	52.67	15.85	55
56	53.83	15.44	53.76	15.67	53.69	15.90	53.62	16.14	56
57	54.79	15.71	54.72	15.95	54.65	16.19	54.58	16.43	57
58	55.75	15.99	55.68	16.23	55.61	16.47	55.54	16.72	58
59	56.71	16.26	56.64	16.51	56.57	16.76	56.50	17.00	59
60	57.68	16.54	57.60	16.79	57.53	17.04	57.45	17.29	60
61	58.64	16.81	58.56	17.07	58.49	17.32	58.41	17.58	61
62	59.60	17.09	59.52	17.35	59.45	17.61	59.37	17.87	62
63	60.56	17.37	60.48	17.63	60.41	17.89	60.33	18.16	63
64	61.52	17.64	61.44	17.91	61.36	18.18	61.28	18.44	64
65	62.48	17.92	62.40	18.19	62.32	18.46	62.24	18.73	65
66	63.44	18.19	63.36	18.47	63.28	18.74	63.20	19.02	66
67	64.40	18.47	64.32	18.75	64.24	19.03	64.16	19.31	67
68	65.37	18.74	65.28	19.03	65.20	19.31	65.11	19.60	68
69	66.33	19.02	66.24	19.31	66.16	19.60	66.07	19.89	69
70	67.29	19.29	67.20	19.59	67.12	19.88	67.03	20.17	70
71	68.25	19.57	68.16	19.87	68.08	20.17	67.99	20.46	71
72	69.21	19.85	69.12	20.15	69.03	20.45	68.95	20.75	72
73	70.17	20.12	70.08	20.43	69.99	20.73	69.90	21.04	73
74	71.13	20.40	71.04	20.71	70.95	21.02	70.86	21.33	74
75	72.09	20.67	72.00	20.99	71.91	21.30	71.82	21.61	75
76	73.06	20.95	72.96	21.27	72.87	21.59	72.78	21.90	76
77	74.02	21.22	73.92	21.55	73.83	21.87	73.73	22.19	77
78	75.98	21.50	74.88	21.83	74.79	22.15	74.69	22.48	78
79	76.94	21.78	75.84	22.11	75.75	22.44	75.65	22.77	79
80	76.90	22.05	76.80	22.39	76.71	22.72	76.61	23.06	80
81	77.86	22.33	77.76	22.67	77.66	23.01	77.56	23.34	81
82	78.82	22.60	78.72	22.95	78.62	23.29	78.52	23.63	82
83	79.78	22.88	79.68	23.23	79.58	23.57	79.48	23.92	83
84	80.75	23.15	80.64	23.51	80.54	23.86	80.44	24.21	84
85	81.71	23.43	81.60	23.79	81.50	24.14	81.39	24.50	85
86	82.67	23.70	82.56	24.07	82.46	24.43	82.35	24.78	86
87	83.63	23.98	83.52	24.35	83.42	24.71	83.31	25.07	87
88	84.59	24.26	84.48	24.62	84.38	24.99	84.27	25.36	88
89	85.55	24.53	85.44	24.90	85.33	25.28	85.22	25.65	89
90	86.51	24.81	86.40	25.18	86.29	25.56	86.18	25.94	90
91	87.47	25.08	87.36	25.46	87.25	25.85	87.14	26.23	91
92	88.44	25.36	88.32	25.74	88.21	26.13	88.10	26.51	92
93	89.40	25.63	89.28	26.02	89.17	26.41	89.05	26.80	93
94	90.36	25.91	90.24	26.30	90.13	26.70	90.01	27.09	94
95	91.32	26.19	91.20	26.58	91.09	26.98	90.97	27.38	95
96	92.28	26.46	92.16	26.86	92.05	27.27	91.93	27.67	96
97	93.24	26.74	93.12	27.14	93.01	27.55	92.88	27.95	97
98	94.20	27.01	94.08	27.42	93.96	27.83	93.84	28.24	98
99	95.16	27.29	95.04	27.70	94.92	28.12	94.80	28.53	99
100	96.13	27.56	96.00	27.98	95.88	28.40	95.76	28.82	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	74 Deg.		73¾ Deg.		73½ Deg.		73¼ Deg.		

Dist.	17 Deg.		17¼ Deg.		17½ Deg.		17¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.96	0.29	0.95	0.30	0.95	0.30	0.95	0.30	1
2	1.91	0.58	1.91	0.59	1.91	0.60	1.90	0.61	2
3	2.87	0.88	2.87	0.89	2.86	0.90	2.86	0.91	3
4	3.83	1.17	3.82	1.19	3.81	1.20	3.81	1.22	4
5	4.78	1.46	4.78	1.48	4.77	1.50	4.76	1.52	5
6	5.74	1.75	5.73	1.78	5.72	1.80	5.71	1.83	6
7	6.69	2.05	6.69	2.08	6.68	2.10	6.67	2.13	7
8	7.65	2.34	7.04	2.37	7.63	2.41	7.62	2.44	8
9	8.61	2.63	8.60	2.67	8.58	2.71	8.57	2.74	9
10	9.56	2.92	9.55	2.97	9.54	3.01	9.52	3.05	10
11	10.52	3.22	10.51	3.26	10.49	3.31	10.48	3.35	11
12	11.48	3.51	11.46	3.50	11.44	3.61	11.43	3.66	12
13	12.43	3.80	12.42	3.85	12.40	3.91	12.38	3.96	13
14	13.39	4.09	13.37	4.15	13.35	4.21	13.33	4.27	14
15	14.34	4.39	14.33	4.45	14.31	4.51	14.29	4.57	15
16	15.30	4.68	15.28	4.74	15.26	4.81	15.24	4.88	16
17	16.26	4.97	16.24	5.04	16.21	5.11	16.19	5.18	17
18	17.21	5.26	17.19	5.34	17.17	5.41	17.14	5.49	18
19	18.17	5.56	18.15	5.63	18.12	5.71	18.10	5.79	19
20	19.13	5.85	19.10	5.93	19.07	6.01	19.05	6.10	20
21	20.08	6.14	20.06	6.23	20.03	6.31	20.00	6.40	21
22	21.04	6.43	21.01	6.52	20.98	6.62	20.95	6.71	22
23	21.99	6.72	21.97	6.82	21.94	6.92	21.91	7.01	23
24	22.95	7.02	22.92	7.12	22.89	7.22	22.86	7.32	24
25	23.91	7.31	23.88	7.41	23.84	7.52	23.81	7.62	25
26	24.86	7.60	24.83	7.71	24.80	7.82	24.76	7.93	26
27	25.82	7.89	25.79	8.01	25.75	8.12	25.71	8.23	27
28	26.78	8.19	26.74	8.30	26.70	8.42	26.67	8.54	28
29	27.73	8.48	27.70	8.60	27.66	8.72	27.62	8.84	29
30	28.69	8.77	28.65	8.90	28.61	9.02	28.57	9.15	30
31	29.65	9.06	29.61	9.19	29.57	9.32	29.52	9.45	31
32	30.60	9.36	30.56	9.49	30.52	9.62	30.48	9.76	32
33	31.56	9.65	31.52	9.79	31.47	9.92	31.43	10.06	33
34	32.51	9.94	32.47	10.08	32.42	10.22	32.38	10.37	34
35	33.47	10.23	33.43	10.38	33.38	10.52	33.33	10.67	35
36	34.43	10.53	34.38	10.68	34.33	10.83	34.29	10.98	36
37	35.38	10.82	35.34	10.97	35.29	11.13	35.24	11.28	37
38	36.34	11.11	36.29	11.27	36.24	11.43	36.19	11.58	38
39	37.30	11.40	37.25	11.57	37.19	11.73	37.14	11.89	39
40	38.25	11.69	38.20	11.86	38.15	12.03	38.10	12.19	40
41	39.21	11.99	39.16	12.16	39.10	12.33	39.05	12.50	41
42	40.16	12.28	40.11	12.45	40.06	12.63	40.00	12.80	42
43	41.12	12.57	41.07	12.75	41.01	12.93	40.95	13.11	43
44	42.08	12.86	42.02	13.05	41.96	13.23	41.91	13.41	44
45	43.03	13.16	42.98	13.34	42.92	13.53	42.86	13.72	45
46	43.99	13.45	43.93	13.64	43.87	13.83	43.81	14.02	46
47	44.95	13.74	44.89	13.94	44.82	14.13	44.76	14.33	47
48	45.90	14.03	45.84	14.23	45.78	14.43	45.71	14.63	48
49	46.86	14.33	46.80	14.53	46.73	14.73	46.67	14.94	49
50	47.82	14.62	47.75	14.83	47.69	15.04	47.62	15.24	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	73 Deg.		72¾ Deg.		72½ Deg.		72¼ Deg.		

Dist.	17 Deg.		17¼ Deg.		17½ Deg.		17¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	48.77	14.91	48.71	15.12	48.64	15.34	48.57	15.55	51
52	49.73	15.20	49.66	15.42	49.59	15.64	49.52	15.85	52
53	50.68	15.50	50.62	15.72	50.55	15.94	50.48	16.16	53
54	51.64	15.79	51.57	16.01	51.50	16.24	51.43	16.46	54
55	52.60	16.08	52.53	16.31	52.45	16.54	52.38	16.77	55
56	53.55	16.37	53.48	16.61	53.41	16.84	53.33	17.07	56
57	54.51	16.67	54.44	16.90	54.36	17.14	54.29	17.38	57
58	55.47	16.96	55.39	17.20	55.32	17.44	55.24	17.68	58
59	56.42	17.25	56.35	17.50	56.27	17.74	56.19	17.99	59
60	57.38	17.54	57.30	17.79	57.22	18.04	57.14	18.29	60
61	58.33	17.83	58.26	18.09	58.18	18.34	58.10	18.60	61
62	59.29	18.13	59.21	18.39	59.13	18.64	59.05	18.90	62
63	60.25	18.42	60.17	18.68	60.08	18.94	60.00	19.21	63
64	61.20	18.71	61.12	18.98	61.04	19.25	60.95	19.51	64
65	62.16	19.00	62.08	19.28	61.99	19.55	61.91	19.82	65
66	63.12	19.30	63.03	19.57	62.95	19.85	62.86	20.12	66
67	64.07	19.59	63.99	19.87	63.90	20.15	63.81	20.43	67
68	65.03	19.88	64.94	20.16	64.85	20.45	64.76	20.73	68
69	65.99	20.17	65.90	20.46	65.81	20.75	65.72	21.04	69
70	66.94	20.47	66.85	20.76	66.76	21.05	66.67	21.34	70
71	67.90	20.76	67.81	21.05	67.71	21.35	67.62	21.65	71
72	68.85	21.05	68.76	21.35	68.07	21.65	68.57	21.95	72
73	69.81	21.34	69.74	21.05	69.62	21.95	69.52	22.26	73
74	70.77	21.04	70.67	21.94	70.58	22.25	70.48	22.56	74
75	71.72	21.93	71.63	22.24	71.53	22.55	71.43	22.86	75
76	72.68	22.22	72.58	22.54	72.48	22.85	72.38	23.17	76
77	73.64	22.51	73.54	22.83	73.44	23.15	73.33	23.47	77
78	74.59	22.80	74.49	23.13	74.39	23.46	74.29	23.78	78
79	75.55	23.10	75.45	23.43	75.34	23.76	75.24	24.08	79
80	76.50	23.39	76.40	23.72	76.30	24.06	76.19	24.39	80
81	77.46	23.68	77.36	24.02	77.25	24.36	77.14	24.69	81
82	78.42	23.97	78.31	24.32	78.20	24.66	78.10	25.00	82
83	79.37	24.27	79.27	24.01	79.16	24.96	79.05	25.30	83
84	80.33	24.56	80.22	24.91	80.11	25.26	80.00	25.61	84
85	81.29	24.85	81.18	25.21	81.07	25.56	80.95	25.91	85
86	82.24	25.14	82.13	25.50	82.02	25.86	81.91	26.22	86
87	83.20	25.44	83.09	25.80	82.97	26.16	82.86	26.52	87
88	84.15	25.73	84.04	26.10	83.93	26.46	83.81	26.83	88
89	85.11	26.02	85.00	26.39	84.88	26.76	84.76	27.13	89
90	86.07	26.31	85.95	26.69	85.83	27.06	85.72	27.44	90
91	87.02	26.61	86.91	26.99	86.79	27.36	86.67	27.74	91
92	87.98	26.90	87.86	27.28	87.74	27.66	87.62	28.05	92
93	88.94	27.19	88.82	27.58	88.70	27.97	88.57	28.35	93
94	89.89	27.48	89.77	27.87	89.65	28.27	89.53	28.66	94
95	90.85	27.78	90.73	28.17	90.60	28.57	90.48	28.96	95
96	91.81	28.07	91.68	28.47	91.56	28.87	91.43	29.27	96
97	92.76	28.36	92.64	28.76	92.51	29.17	92.38	29.57	97
98	93.72	28.65	93.59	29.06	93.46	29.47	93.33	29.88	98
99	94.67	28.94	94.55	29.36	94.42	29.77	94.29	30.18	99
100	95.63	29.24	95.50	29.65	95.37	30.07	95.24	30.49	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	73 Deg.		72¾ Deg.		72½ Deg.		72¼ Deg.		

Dist.	18 Deg.		18¼ Deg.		18½ Deg.		18¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,95	0,31	0,95	0,31	0,95	0,32	0,95	0,32	1
2	1,90	0,62	1,90	0,63	1,90	0,63	1,89	0,64	2
3	2,85	0,93	2,85	0,94	2,84	0,95	2,84	0,96	3
4	3,80	1,24	3,80	1,25	3,79	1,27	3,79	1,29	4
5	4,76	1,55	4,75	1,57	4,74	1,59	4,73	1,61	5
6	5,71	1,85	5,70	1,88	5,69	1,90	5,68	1,93	6
7	6,66	2,16	6,65	2,19	6,64	2,22	6,63	2,25	7
8	7,61	2,47	7,60	2,51	7,59	2,54	7,58	2,57	8
9	8,56	2,78	8,55	2,82	8,53	2,86	8,52	2,89	9
10	9,51	3,09	9,50	3,13	9,48	3,17	9,47	3,21	10
11	10,46	3,40	10,45	3,44	10,43	3,49	10,42	3,54	11
12	11,41	3,71	11,40	3,76	11,38	3,81	11,36	3,86	12
13	12,36	4,02	12,35	4,07	12,33	4,12	12,31	4,18	13
14	13,31	4,33	13,30	4,38	13,28	4,44	13,26	4,50	14
15	14,27	4,64	14,25	4,70	14,22	4,70	14,20	4,82	15
16	15,22	4,94	15,20	5,01	15,17	5,08	15,15	5,14	16
17	16,17	5,25	16,14	5,32	16,12	5,39	16,10	5,46	17
18	17,12	5,56	17,09	5,64	17,07	5,71	17,04	5,79	18
19	18,07	5,87	18,04	5,95	18,02	6,03	17,99	6,11	19
20	19,02	6,18	18,99	6,26	18,97	6,35	18,94	6,43	20
21	19.97	6,49	19,94	6,58	19,91	6,66	19,89	6,75	21
22	20,92	6,80	20,89	6,89	20,86	6,98	20,83	7,07	22
23	21,87	7,11	21,84	7,20	21,81	7,30	21,78	7,39	23
24	22,83	7,42	22,79	7,52	22,76	7,62	22,73	7,71	24
25	23,78	7,73	23,74	7,83	23,71	7,93	23,67	8,04	25
26	24,73	8,03	24,69	8,14	24,66	8,25	24,62	8,36	26
27	25,68	8,34	25,64	8,46	25,60	8,57	25,57	8,68	27
28	26,63	8,65	26,59	8,77	26,55	8,88	26,51	9,00	28
29	27,58	8,96	27,54	9,08	27,50	9,20	27.46	9,32	29
30	28,53	9,27	28,49	9,39	28,45	9,52	28,41	9,64	30
31	29,48	9,58	29,44	9,71	29,40	9,84	29,35	9,96	31
32	30,43	9,89	30,39	10,02	30,35	10,15	30,30	10,29	32
33	31,38	10,20	31,34	10,33	31,29	10,47	31,25	10,61	33
34	32,34	10,51	32,29	10,65	32,24	10,79	32,20	10,93	34
35	33,29	10,82	33,24	10,96	33,19	11,11	33,14	11,25	35
36	34,24	11,12	34,19	11,27	34,14	11,42	34,09	11,57	36
37	35,19	11,43	35.14	11,59	35,09	11,74	35,04	11,89	37
38	36 14	11,74	36,09	11,90	36,04	12,06	35,98	12,21	38
39	37,09	12,05	37,04	12,21	36,98	12,37	36,93	12,54	39
40	38,04	12,36	37,99	12,53	37,93	12,69	37,88	12,86	40
41	38,99	12,67	38,94	12,84	38,88	13,01	38,82	13,18	41
42	39,94	12,98	39,89	13,15	39,83	13,33	39,77	13,50	42
43	40,90	13,29	40,84	13,47	40,78	13,64	40,72	13,82	43
44	41,85	13,60	41,79	13,78	41,73	13,96	41,66	14,14	44
45	42,80	13,91	42,74	14,09	42,67	14,28	42,61	14,46	45
46	43,75	14,21	43,69	14,41	43,62	14,60	43,56	14,79	46
47	44,70	14,52	44.64	14,72	44,57	14,91	44,51	15,11	47
48	45,65	14,83	45,59	15,03	45,52	15,23	45,45	15,43	48
49	46,60	15,14	46,54	15,35	46,47	15,55	46,40	15,75	49
50	47,55	15,45	47,48	15,66	47,42	15,87	47,35	16,07	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	72 Deg		71¾ Deg.		71½ Deg.		71¼ Deg.		Dist.

Dist.	18 Deg.		18¼ Deg.		18½ Deg.		8¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	48,50	15,76	48,43	15,97	48,36	16,18	48,29	16,39	51
52	49,45	16,07	49,38	16,28	49,31	16,50	49,24	16,71	52
53	50,41	16,38	50,33	16,60	50,26	16,82	50,19	17,04	53
54	51,36	16,69	51,28	16,91	51,21	17,13	51,13	17,36	54
55	52,31	17,00	52,23	17,22	52,16	17,45	52,08	17,68	55
56	53,26	17,30	53,18	17,54	53,11	17,77	53,03	18,00	56
57	54,21	17,61	54,13	17,85	54,05	18,09	53,98	18,32	57
58	55,16	17,92	55,08	18,16	55,00	18,40	54,92	18,64	58
59	56,11	18,23	56,03	18,48	55,95	18,72	55,87	18,96	59
60	57,06	18,54	56,98	18,79	56,90	19,04	56,82	19,29	60
61	58,01	18,85	57,93	19,10	57,85	19,36	57,76	19,61	61
62	58,97	19,16	58,88	19,42	58,80	19,67	58,71	19,93	62
63	59,92	19,47	59,83	19,73	59,74	19,99	59,66	20,25	63
64	60,87	19,78	60,78	20,04	60,69	20,31	60,60	20,57	64
65	61,82	20,09	61,73	20,36	61,64	20,62	61,55	20,89	65
66	62,77	20,40	62,68	20,67	62,59	20,94	62,50	21,22	66
67	63,72	20,70	63,63	20,98	63,54	21,26	63,44	21,54	67
68	64,67	21,01	64,58	21,30	64,49	21,58	64,39	21,86	68
69	65,62	21,32	65,53	21,61	65,43	21,89	65,34	22,18	69
70	66,57	21,63	66,48	21,92	66,38	22,21	66,29	22,50	70
71	67,53	21,94	67,43	22,23	67,33	22,53	67,23	22,82	71
72	68,48	22,25	68,38	22,55	68,28	22,85	68,18	23,14	72
73	69,43	22,56	69,33	22,86	69,23	23,16	69,13	23,47	73
74	70,38	22,87	70,28	23,17	70,18	23,48	70,07	23,79	74
75	71,33	23,18	71,23	23,49	71,12	23,80	71,02	24,11	75
76	72,28	23,49	72,18	23,80	72,07	24,12	71,97	24,43	76
77	73,23	23,79	73,13	24,11	73,02	24,43	72,91	24,75	77
78	74,18	24,10	74,08	24,43	73,97	24,75	73,86	25,07	78
79	75,13	24,41	75,03	24,74	74,92	25,07	74,81	25,39	79
80	76,08	24,72	75,98	25,05	75,87	25,38	75,75	25,72	80
81	77,04	25,03	76,93	25,37	76,81	25,70	76,70	26,04	81
82	77,99	25,34	77,88	25,68	77,76	26,02	77,65	26,36	82
83	78,94	25,65	78,83	25,99	78,71	26,34	78,00	26,68	83
84	79,89	25,96	79,77	26,31	79,66	26,65	79,54	27,00	84
85	80,84	26,27	80,72	26,62	80,61	26,97	80,49	27,32	85
86	81,79	26,58	81,67	26,93	81,56	27,29	81,44	27,64	86
87	82,74	26,88	82,62	27,25	82,50	27,61	82,38	27,97	87
88	83,69	27,19	83,57	27,56	83,45	27,92	83,33	28,29	88
89	84,64	27,50	84,52	27,87	84,40	28,24	84,28	28,01	89
90	85,60	27,81	85,47	28,18	85,35	28,56	85,22	28,93	90
91	86,55	28,12	86,42	28,50	86,30	28,87	86,17	29,25	91
92	87,50	28,43	87,37	28,81	87,25	29,19	87,12	29,57	92
93	88,45	28,74	88 32	29,12	88,19	29,51	88,06	29,89	93
94	89,40	29,05	89,27	29,44	89,14	29,83	89,01	30,22	94
95	90,35	29,36	90,22	29,75	90,09	30,14	89,96	30,54	95
96	91,30	29,67	91,17	30,06	91,04	30,46	90,91	30,86	96
97	92,25	29,97	92,12	30,38	91,99	30,78	91,85	31,18	97
98	93,20	30,28	93,07	30,69	92,94	31,10	92,80	31,50	98
99	94,15	30,59	94,02	31,00	93,88	31,41	93,75	31,82	99
100	95,11	30,90	94,97	31,32	94,83	31,73	94,69	32,14	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	72 Deg.		71¾ Deg.		71½ Deg.		71¼ Deg.		Dist.

Dist.	19 Deg.		19¼ Deg.		19½ Deg.		19¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.95	0.33	0.94	0.33	0.94	0.33	0.94	0.34	1
2	1.89	0.65	1.89	0.66	1.89	0.67	1.88	0.68	2
3	2.84	0.98	2.83	0.99	2.83	1.00	2.82	1.01	3
4	3.78	1.30	3.78	1.32	3.77	1.34	3.76	1.35	4
5	4.73	1.63	4.72	1.65	4.71	1.67	4.71	1.69	5
6	5.67	1.95	5.66	1.98	5.66	2.00	5.65	2.03	6
7	6.62	2.28	6.61	2.31	6.60	2.34	6.59	2.37	7
8	7.56	2.60	7.55	2.64	7.54	2.67	7.53	2.70	8
9	8.51	2.93	8.50	2.97	8.48	3.00	8.47	3.04	9
10	9.46	3.26	9.44	3.30	9.43	3.34	9.41	3.38	10
11	10.40	3.58	10.38	3.63	10.37	3.67	10.35	3.72	11
12	11.35	3.91	11.33	3.96	11.31	4.01	11.29	4.06	12
13	12.29	4.23	12.27	4.29	12.25	4.34	12.24	4.39	13
14	13.24	4.56	13.22	4.62	13.20	4.67	13.18	4.73	14
15	14.18	4.88	14.16	4.95	14.14	5.01	14.12	5.07	15
16	15.13	5.21	15.11	5.28	15.08	5.34	15.06	5.41	16
17	16.07	5.53	16.05	5.60	16.02	5.67	16.00	5.74	17
18	17.02	5.86	16.99	5.93	16.97	6.01	16.94	6.08	18
19	17.96	6.19	17.94	6.26	17.91	6.34	17.88	6.42	19
20	18.91	6.51	18.88	6.59	18.85	6.68	18.82	6.76	20
21	19.86	6.84	19.83	6.92	19.80	7.01	19.76	7.10	21
22	20.80	7.16	20.77	7.25	20.74	7.34	20.71	7.43	22
23	21.75	7.49	21.71	7.58	21.68	7.68	21.65	7.77	23
24	22.69	7.81	22.66	7.91	22.62	8.01	22.59	8.11	24
25	23.64	8.14	23.60	8.24	23.57	8.35	23.53	8.45	25
26	24.58	8.46	24.55	8.57	24.51	8.68	24.47	8.79	26
27	25.53	8.79	25.49	8.90	25.45	9.01	25.41	9.12	27
28	26.47	9.12	26.43	9.23	26.39	9.35	26.35	9.46	28
29	27.42	9.44	27.38	9.56	27.34	9.68	27.29	9.80	29
30	28.37	9.77	28.32	9.89	28.28	10.01	28.24	10.14	30
31	29.31	10.09	29.27	10.22	29.22	10.35	29.18	10.48	31
32	30.26	10.42	30.21	10.55	30.16	10.68	30.12	10.81	32
33	31.20	10.74	31.15	10.88	31.11	11.02	31.06	11.15	33
34	32.15	11.07	32.10	11.21	32.05	11.35	32.00	11.49	34
35	33.09	11.39	33.04	11.54	32.99	11.68	32.94	11.83	35
36	34.04	11.72	33.99	11.87	33.94	12.02	33.88	12.17	36
37	34.98	12.05	34.93	12.20	34.88	12.35	34.82	12.50	37
38	35.93	12.37	35.88	12.53	35.82	12.68	35.76	12.84	38
39	36.88	12.70	36.82	12.86	36.76	13.02	36.71	13.18	39
40	37.82	13.02	37.76	13.19	37.71	13.35	37.65	13.52	40
41	38.77	13.35	38.71	13.52	38.65	13.69	38.59	13.85	41
42	39.71	13.67	39.65	13.85	39.59	14.02	39.53	14.19	42
43	40.66	14.00	40.60	14.18	40.53	14.35	40.47	14.53	43
44	41.60	14.32	41.54	14.51	41.48	14.69	41.41	14.87	44
45	42.55	14.65	42.48	14.84	42.42	15.02	42.35	15.21	45
46	43.49	14.98	43.43	15.17	43.36	15.36	43.29	15.54	46
47	44.44	15.30	44.37	15.50	44.30	15.69	44.24	15.88	47
48	45.38	15.63	45.32	15.83	45.25	16.02	45.18	16.22	48
49	46.33	15.95	46.26	16.15	46.19	16.36	46.12	16.56	49
50	47.28	16.28	47.20	16.48	47.13	16.69	47.06	16.90	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	71 Deg.		70¾ Deg.		70½ Deg.		70¼ Deg		

Dist.	19 Deg		19¼ Deg.		19½ Deg.		19¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	48,22	16,60	48,15	16,81	48,07	17,02	48,00	17,23	51
52	49,17	16,93	49,09	17,14	49,02	17,36	48,94	19,57	52
53	50,11	17,26	50,04	17,47	49,96	17,69	49,88	17,91	53
54	51,06	17,58	50.98	17,80	50,90	18,03	50,82	18,25	54
55	52,00	17,91	51,92	18,13	51,85	18,36	51,76	18,59	55
56	52,95	18,23	52,86	18,46	52,79	18,69	52,71	18,92	56
57	53,89	18,56	53,81	18,79	53,73	19,03	53,65	19,26	57
58	54,84	18,88	54,76	19,12	54,67	19,36	54,59	19,60	58
59	55,79	19,21	55,70	19,45	55,62	19,69	55,53	19,94	59
60	56,73	19,53	56,65	19,78	56,56	20,03	56,47	20,27	60
61	57,68	19,86	57,59	20,11	57,50	20,36	57,41	20,61	61
62	58,62	20,19	58,53	20,44	58,44	20,70	58,35	20,95	62
63	59,57	20,51	59,48	20,77	59,39	21,03	59,29	21,29	63
64	60,51	20,84	60,42	21,10	60,33	21,36	60,24	21,03	64
65	61,46	21,16	61,37	21,43	61,27	21,70	61,18	21,96	65
66	62,40	21,49	62,31	21,76	62,21	22,03	62,12	22,30	66
67	63,35	21,81	63,25	22,09	63,16	22,37	63,06	22,64	67
68	64,30	22,14	64,20	22,42	64,10	22,70	64,00	22,98	68
69	65,24	22,46	65,14	22,75	65,04	23,03	64,94	23,32	69
70	66,19	22,79	66,09	23,08	65,98	23,37	65,68	23,05	70
71	67,13	23,12	67,03	23,41	66,93	23,70	66,82	23,99	71
72	68,08	23,44	67,97	23,74	67,87	24,03	67,76	24,33	72
73	69,02	23,77	68,92	24,07	68,81	24,37	68,71	24,67	73
74	69,97	24,09	69,86	24,40	69,76	24,70	69,65	25,01	74
75	70,91	24,42	70,81	24,73	70,70	25,04	70,59	25,34	75
76	71,86	24,74	71,75	25,06	71,64	25,37	71,53	25,68	76
77	72,80	25,07	72,69	25,39	72,58	25,70	72,47	26,02	77
78	73,75	25,39	73,64	25,72	73,53	26,04	73,41	26,36	78
79	74,70	25,72	74,58	26,05	74,47	26,37	74,35	26,70	79
80	75,64	26,05	75,53	26,38	75,41	26,70	75,29	27,03	80
81	76,59	26,37	76,47	26,70	76,35	27,04	76,24	27,37	81
82	77,53	26,70	77,42	27,03	77,30	27,37	77,18	27,71	82
83	78,48	27,02	78,36	27,36	78,24	27,71	78,12	28,05	83
84	79,42	27,35	79,30	27,69	79,18	28,04	79,06	28,39	84
85	80,37	27,67	80,25	28,02	80,12	28,37	80,00	28,72	85
86	81,31	28,00	81,19	28,35	81,07	28,71	80,94	29,06	86
87	82,26	28,32	82,14	28,68	82,01	29,04	81,88	29,40	87
88	83,21	28,65	83,08	29,01	82,95	29,37	82,82	29,74	88
89	84,15	28,98	84,02	29,34	83,90	29,71	83,76	30,07	89
90	85,10	29,30	84,97	29,67	84,84	30,04	84,71	30,41	90
91	86.04	29,63	85,91	30,00	85,78	30,38	85,65	30,75	91
92	86,99	29,95	86,86	30,33	86,72	30,71	86,59	31,09	92
93	87,93	30,28	87,80	30,66	87,67	31,04	87,53	31,43	93
94	88,88	30,60	88,74	30,99	88,61	31,38	88,47	31,76	94
95	89,82	30,93	89,69	31,32	89,55	31,71	89,41	32,10	95
96	90,77	31,25	90,63	31,65	90,49	32,05	90,35	32,44	96
97	91,72	31,58	91,58	31,98	91,44	32,38	91,29	32,78	97
98	92,66	31,91	92,52	32,31	92,38	32,71	92,24	33,12	98
99	93,61	32,23	93,46	32,64	93,32	33,05	93,18	33,45	99
100	94,55	32,56	94,41	32,97	94,26	33,38	94,12	33,79	100
Dist.	Dep.	Lat.	Dep	Lat.	Dep	Lat.	Dep.	Lat.	Dist.
	71 Deg.		70¾ Deg.		70½ D		70¼ Deg		

Diſt.	20 Deg.		20¼ Deg.		20½ Deg.		20¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.94	0.34	0.94	0.35	0.94	0.35	0.94	0.35	1
2	1.88	0.68	1.88	0.69	1.87	0.70	1.87	0.71	2
3	2.82	1.03	2.81	1.04	2.81	1.05	2.81	1.06	3
4	3.76	1.37	3.75	1.38	3.75	1.40	3.74	1.42	4
5	4.70	1.71	4.69	1.73	4.68	1.75	4.68	1.77	5
6	5.64	2.05	5.63	2.08	5.62	2.10	5.61	2.13	6
7	6.58	2.39	6.57	2.42	6.56	2.45	6.55	2.48	7
8	7.52	2.74	7.51	2.77	7.49	2.80	7.48	2.83	8
9	8.46	3.08	8.44	3.12	8.43	3.15	8.42	3.19	9
10	9.40	3.42	9.38	3.46	9.37	3.50	9.35	3.54	10
11	10.34	3.76	10.32	3.81	10.30	3.85	10.29	3.90	11
12	11.28	4.10	11.26	4.15	11.24	4.20	11.22	4.25	12
13	12.22	4.45	12.20	4.50	12.18	4.55	12.16	4.61	13
14	13.16	4.79	13.13	4.85	13.11	4.90	13.09	4.96	14
15	14.10	5.13	14.07	5.19	14.05	5.25	14.03	5.31	15
16	15.04	5.47	15.01	5.54	14.99	5.60	14.96	5.67	16
17	15.97	5.81	15.95	5.88	15.92	5.95	15.90	6.02	17
18	16.91	6.16	16.89	6.23	16.86	6.30	16.83	6.38	18
19	17.85	6.50	17.83	6.58	17.80	6.65	17.77	6.73	19
20	18.79	6.84	18.76	6.92	18.73	7.00	18.70	7.09	20
21	19.73	7.18	19.70	7.27	19.67	7.35	19.64	7.44	21
22	20.67	7.52	20.64	7.61	20.61	7.70	20.57	7.79	22
23	21.61	7.87	21.58	7.96	21.54	8.05	21.51	8.15	23
24	22.55	8.21	22.52	8.31	22.48	8.40	22.44	8.50	24
25	23.49	8.55	23.45	8.65	23.42	8.76	23.38	8.86	25
26	24.43	8.89	24.39	9.00	24.35	9.11	24.31	9.21	26
27	25.37	9.23	25.33	9.35	25.29	9.46	25.25	9.57	27
28	26.31	9.58	26.27	9.69	26.23	9.81	26.18	9.92	28
29	27.25	9.92	27.21	10.04	27.16	10.16	27.12	10.27	29
30	28.19	10.26	28.15	10.38	28.10	10.51	28.05	10.63	30
31	29.13	10.60	29.08	10.73	29.04	10.86	28.99	10.98	31
32	30.07	10.94	30.02	11.08	29.97	11.21	29.92	11.34	32
33	31.01	11.29	30.96	11.42	30.91	11.56	30.86	11.69	33
34	31.95	11.63	31.90	11.77	31.85	11.91	31.79	12.05	34
35	32.89	11.97	32.84	12.11	32.78	12.26	32.73	12.40	35
36	33.83	12.31	33.77	12.46	33.72	12.61	33.66	12.75	36
37	34.77	12.65	34.71	12.81	34.66	12.96	34.60	13.11	37
38	35.71	13.00	35.65	13.15	35.59	13.31	35.54	13.46	38
39	36.65	13.34	36.59	13.50	36.53	13.66	36.47	13.82	39
40	37.59	13.68	37.53	13.84	37.47	14.01	37.41	14.17	40
41	38.53	14.02	38.47	14.19	38.40	14.36	38.34	14.53	41
42	39.47	14.36	39.40	14.54	39.34	14.71	39.28	14.88	42
43	40.41	14.71	40.34	14.88	40.28	15.06	40.21	15.23	43
44	41.35	15.05	41.28	15.23	41.21	15.41	41.15	15.59	44
45	42.29	15.39	42.22	15.58	42.15	15.76	42.08	15.94	45
46	43.23	15.73	43.16	15.92	43.09	16.11	43.02	16.30	46
47	44.17	16.07	44.09	16.27	44.02	16.46	43.95	16.65	47
48	45.11	16.42	45.03	16.61	44.96	16.81	44.89	17.01	48
49	46.04	16.76	45.97	16.96	45.90	17.16	45.82	17.36	49
50	46.98	17.10	46.91	17.31	46.83	17.51	46.76	17.71	50
Diſt.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	70 Deg		69¾ Deg.		69½ Deg.		69¼ Deg.		

Dist.	20 Deg.		20¼ Deg		20½ Deg.		20¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	47.92	17.44	47.85	17.65	47.77	17.86	47.69	18.07	51
52	48.86	17.79	48.79	18.00	48.71	18.21	48.63	18.42	52
53	49.80	18.13	49.72	18.34	49.64	18.56	49.56	18.78	53
54	50.74	18.47	50.66	18.69	50.58	18.91	50.50	19.13	54
55	51.68	18.81	51.60	19.04	51.52	19.26	51.43	19.49	55
56	52.62	19.15	52.54	19.38	52.45	19.61	52.37	19.84	56
57	53.56	19.50	53.48	19.73	53.39	19.96	53.30	20.19	57
58	54.50	19.84	54.42	20.07	54.33	20.31	54.24	20.55	58
59	55.44	20.18	55.35	20.42	55.26	20.66	55.17	20.90	59
60	56.38	20.52	56.29	20.77	56.20	21.01	56.11	21.26	60
61	57.32	20.86	57.23	21.11	57.14	21.36	57.04	21.61	61
62	58.26	21.21	58.17	21.46	58.07	21.71	57.98	21.97	62
63	59.20	21.55	59.11	21.81	59.01	22.06	58.91	22.32	63
64	60.14	21.89	60.04	22.15	59.95	22.41	59.85	22.67	64
65	61.08	22.23	60.98	22.50	60.88	22.76	60.78	23.03	65
66	62.02	22.57	61.92	22.84	61.82	23.11	61.72	23.38	66
67	62.96	22.92	62.86	23.19	62.76	23.46	62.65	23.74	67
68	63.90	23.26	63.80	23.54	63.69	23.81	63.59	24.09	68
69	64.84	23.60	64.74	23.88	64.63	24.16	64.52	24.45	69
70	65.78	23.94	65.67	24.23	65.57	24.51	65.46	24.80	70
71	66.72	24.28	66.61	24.57	66.50	24.86	66.39	25.15	71
72	67.66	24.63	67.55	24.92	67.44	25.21	67.33	25.51	72
73	68.60	24.97	68.49	25.27	68.38	25.57	68.26	25.86	73
74	69.54	25.31	69.43	25.61	69.31	25.92	69.20	26.22	74
75	70.48	25.65	70.36	25.96	70.25	26.27	70.14	26.57	75
76	71.42	25.99	71.30	26.30	71.19	26.62	71.07	26.93	76
77	72.36	26.34	72.24	26.65	72.12	26.97	72.01	27.28	77
78	73.30	26.68	73.18	27.00	73.00	27.32	72.94	27.63	78
79	74.24	27.02	74.12	27.34	74.00	27.67	73.88	27.99	79
80	75.18	27.36	75.06	27.69	74.93	28.02	74.81	28.34	80
81	76.12	27.70	75.99	28.04	75.87	28.37	75.75	28.70	81
82	77.05	28.05	76.93	28.38	76.81	28.72	76.68	29.05	82
83	77.99	28.39	77.87	28.73	77.74	29.07	77.62	29.41	83
84	78.93	28.73	78.81	29.07	78.68	29.42	78.55	29.76	84
85	79.87	29.07	79.75	29.42	79.62	29.77	79.49	30.11	85
86	80.81	29.41	80.68	29.77	80.55	30.12	80.42	30.47	86
87	81.75	29.76	81.62	30.11	81.49	30.47	81.36	30.82	87
88	82.69	30.10	82.56	30.46	82.43	30.82	82.29	31.18	88
89	83.63	30.44	83.50	30.80	83.36	31.17	83.23	31.53	89
90	84.57	30.78	84.44	31.15	84.30	31.52	84.16	31.89	90
91	85.51	31.12	85.38	31.50	85.24	31.87	85.10	32.24	91
92	86.45	31.47	86.31	31.84	86.17	32.22	86.03	32.59	92
93	87.39	31.81	87.25	32.19	87.11	32.57	86.97	32.95	93
94	88.33	32.15	88.19	32.54	88.05	32.92	87.90	33.30	94
95	89.27	32.49	89.13	32.88	88.98	33.27	88.84	33.66	95
96	90.21	32.83	90.07	33.23	89.92	33.62	89.77	34.01	96
97	91.15	33.18	91.00	33.57	90.86	33.97	90.71	34.37	97
98	92.09	33.52	91.94	33.92	91.79	34.32	91.64	34.72	98
99	93.03	33.86	92.88	34.27	92.73	34.67	92.58	35.07	99
100	93.97	34.20	93.82	34.61	93.67	35.02	93.51	35.43	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	70 Deg.		69¾ Deg.		69½ Deg.		69¼ Deg.		

Diſt.	21 Deg.		21¼ Deg.		21½ Deg.		21¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.93	0.36	0.93	0.36	0.93	0.37	0.93	0.37	1
2	1.87	0.72	1.86	0.72	1.86	0.73	1.86	0.74	2
3	2.80	1.08	2.80	1.09	2.79	1.10	2.79	1.11	3
4	3.73	1.43	3.73	1.45	3.72	1.47	3.72	1.48	4
5	4.67	1.79	4.66	1.81	4.65	1.83	4.64	1.85	5
6	5.60	2.15	5.59	2.17	5.58	2.20	5.57	2.22	6
7	6.54	2.51	6.52	2.54	6.51	2.57	6.50	2.59	7
8	7.47	2.87	7.46	2.90	7.44	2.93	7.43	2.96	8
9	8.40	3.23	8.39	3.26	8.37	3.30	8.36	3.34	9
10	9.34	3.58	9.32	3.62	9.30	3.67	9.29	3.71	10
11	10.27	3.94	10.25	3.99	10.23	4.03	10.22	4.08	11
12	11.20	4.30	11.18	4.35	11.17	4.40	11.15	4.45	12
13	12.14	4.66	12.12	4.71	12.10	4.76	12.07	4.82	13
14	13.07	5.02	13.05	5.07	13.03	5.13	13.00	5.19	14
15	14.00	5.38	13.98	5.44	13.96	5.50	13.93	5.56	15
16	14.94	5.73	14.91	5.80	14.89	5.86	14.86	5.93	16
17	15.87	6.09	15.84	6.16	15.82	6.23	15.79	6.30	17
18	16.80	6.45	16.78	6.52	16.75	6.60	16.72	6.67	18
19	17.74	6.81	17.71	6.89	17.68	6.96	17.65	7.04	19
20	18.67	7.17	18.64	7.25	18.61	7.33	18.58	7.41	20
21	19.61	7.53	19.57	7.61	19.54	7.70	19.50	7.78	21
22	20.54	7.88	20.50	7.97	20.47	8.06	20.43	8.15	22
23	21.47	8.24	21.44	8.34	21.40	8.43	21.36	8.52	23
24	22.41	8.60	22.37	8.70	22.33	8.80	22.29	8.89	24
25	23.34	8.96	23.30	9.06	23.26	9.16	23.22	9.26	25
26	24.27	9.32	24.23	9.42	24.19	9.53	24.15	9.63	26
27	25.21	9.68	25.16	9.79	25.12	9.90	25.08	10.01	27
28	26.14	10.03	26.10	10.15	26.05	10.26	26.01	10.38	28
29	27.07	10.39	27.03	10.51	26.98	10.63	26.94	10.75	29
30	28.01	10.75	27.96	10.87	27.91	11.00	27.86	11.12	30
31	28.94	11.11	28.89	11.24	28.84	11.36	28.79	11.49	31
32	29.87	11.47	29.82	11.60	29.77	11.73	29.72	11.86	32
33	30.81	11.83	30.76	11.96	30.70	12.09	30.65	12.23	33
34	31.74	12.18	31.69	12.32	31.63	12.46	31.58	12.60	34
35	32.68	12.54	32.62	12.69	32.56	12.83	32.51	12.97	35
36	33.61	12.90	33.55	13.05	33.50	13.19	33.44	13.34	36
37	34.54	13.26	34.48	13.41	34.43	13.56	34.37	13.71	37
38	35.48	13.62	35.42	13.77	35.36	13.93	35.29	14.08	38
39	36.41	13.98	36.35	14.14	36.29	14.29	36.22	14.45	39
40	37.34	14.33	37.28	14.50	37.22	14.66	37.15	14.82	40
41	38.28	14.69	38.21	14.86	38.15	15.03	38.08	15.19	41
42	39.21	15.05	39.14	15.22	39.08	15.39	39.01	15.56	42
43	40.14	15.41	40.08	15.58	40.01	15.76	39.94	15.93	43
44	41.08	15.77	41.01	15.95	40.94	16.13	40.87	16.30	44
45	42.01	16.13	41.94	16.31	41.87	16.49	41.80	16.68	45
46	42.94	16.48	42.87	16.67	42.80	16.86	42.73	17.05	46
47	43.88	16.84	43.80	17.03	43.73	17.23	43.65	17.42	47
48	44.81	17.20	44.74	17.40	44.66	17.59	44.58	17.79	48
49	45.75	17.56	45.67	17.76	45.59	17.96	45.51	18.16	49
50	46.68	17.92	46.60	18.12	46.52	18.33	46.44	18.53	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	69 Deg.		68¾ Deg.		68½ Deg.		68¼ Deg.		

Dist.	21 Deg.		21¼ Deg.		21½ Deg.		21¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	47.61	18.28	47.53	18.48	47.45	18.69	47.37	18.90	51
52	48.55	18.64	48.46	18.85	48.38	19.06	48.30	19.27	52
53	49.48	18.99	49.40	19.21	49.31	19.42	49.23	19.64	53
54	50.41	19.35	50.33	19.57	50.24	19.79	50.16	20.01	54
55	51.35	19.71	51.26	19.93	51.17	20.16	51.08	20.38	55
56	52.28	20.07	52.19	20.30	52.10	20.52	52.01	20.75	56
57	53.21	20.43	53.12	20.66	53.03	20.89	52.94	21.12	57
58	54.15	20.79	54.06	21.02	53.96	21.26	53.87	21.49	58
59	55.08	21.14	54.99	21.38	54.89	21.62	54.80	21.86	59
60	56.01	21.50	55.92	21.75	55.83	21.99	55.73	22.23	60
61	56.95	21.86	56.85	22.11	56.76	22.36	56.66	22.60	61
62	57.88	22.22	57.78	22.47	57.69	22.72	57.59	22.97	62
63	58.82	22.58	58.72	22.83	58.62	23.09	58.52	23.35	63
64	59.75	22.94	59.65	23.20	59.55	23.46	59.44	23.72	64
65	60.68	23.29	60.58	23.56	60.48	23.82	60.37	24.09	65
66	61.62	23.65	61.51	23.92	61.41	24.19	61.30	24.46	66
67	62.55	24.01	62.44	24.28	62.34	24.56	62.23	24.83	67
68	63.48	24.37	63.38	24.65	63.27	24.92	63.16	25.20	68
69	64.42	24.73	64.31	25.01	64.20	25.29	64.09	25.57	69
70	65.35	25.09	65.24	25.37	65.13	25.66	65.02	25.94	70
71	66.28	25.44	66.17	25.73	66.06	26.02	65.95	26.31	71
72	67.22	25.80	67.10	26.10	66.99	26.39	66.87	26.68	72
73	68.15	26.16	68.04	26.46	67.92	26.75	67.80	27.05	73
74	69.08	26.52	68.97	26.82	68.85	27.12	68.73	27.42	74
75	70.02	26.88	69.90	27.18	69.78	27.49	69.66	27.79	75
76	70.95	27.24	70.83	27.55	70.71	27.85	70.59	28.16	76
77	71.89	27.59	71.76	27.91	71.64	28.22	71.52	28.53	77
78	72.82	27.95	72.70	28.27	72.57	28.59	72.45	28.90	78
79	73.75	28.31	73.63	28.63	73.50	28.95	73.38	29.27	79
80	74.69	28.67	74.56	29.00	74.43	29.32	74.30	29.64	80
81	75.62	29.03	75.49	29.36	75.36	29.69	75.23	30.02	81
82	76.55	29.39	76.42	29.72	76.29	30.05	76.16	30.39	82
83	77.49	29.74	77.36	30.08	77.22	30.42	77.09	30.76	83
84	78.42	30.10	78.29	30.44	78.16	30.79	78.02	31.13	84
85	79.35	30.46	79.22	30.81	79.09	31.15	78.95	31.50	85
86	80.29	30.82	80.15	31.17	80.02	31.52	79.88	31.87	86
87	81.22	31.18	81.08	31.53	80.95	31.89	80.81	32.24	87
88	82.16	31.54	82.02	31.89	81.88	32.25	81.74	32.61	88
89	83.09	31.89	82.95	32.26	82.81	32.62	82.66	32.98	89
90	84.02	32.25	83.88	32.62	83.74	32.99	83.59	33.35	90
91	84.96	32.61	84.81	32.98	84.67	33.35	84.52	33.72	91
92	85.89	32.97	85.74	33.34	85.60	33.72	85.45	34.09	92
93	86.82	33.33	86.68	33.71	86.53	34.08	86.38	34.46	93
94	87.76	33.69	87.61	34.07	87.46	34.45	87.31	34.83	94
95	88.69	34.04	88.54	34.43	88.39	34.82	88.24	35.20	95
96	89.62	34.40	89.47	34.79	89.32	35.18	89.17	35.57	96
97	90.56	34.76	90.40	35.16	90.25	35.55	90.09	35.94	97
98	91.49	35.12	91.34	35.52	91.18	35.92	91.02	36.31	98
99	92.42	35.48	92.27	35.88	92.11	36.28	91.95	36.09	99
100	93.36	35.84	93.20	36.24	93.04	36.65	92.88	37.06	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	69 Deg.		68¾ Deg.		68½ Deg.		68¼ Deg.		

Dist.	22 Deg.		22¼ Deg.		22½ Deg.		22¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,93	0,37	0,93	0,38	0,92	0,38	0,92	0,39	1
2	1,85	0,75	1,85	0,76	1,85	0,77	1,84	0,77	2
3	2,78	1,12	2,78	1,14	2,77	1,15	2,77	1,16	3
4	3,71	1,50	3,70	1,51	3,70	1,53	3,69	1,55	4
5	4,64	1,87	4,63	1,89	4,62	1,91	4,61	1,93	5
6	5,56	2,25	5,55	2,27	5,54	2,30	5,53	2,32	6
7	6,49	2,62	6,48	2,65	6,47	2,68	6,46	2,71	7
8	7,42	3,00	7,40	3,03	7,39	3,06	7,38	3,09	8
9	8,34	3,37	8,33	3,41	8,31	3,44	8,30	3,48	9
10	9,27	3,75	9,26	3,79	9,24	3,83	9,22	3,87	10
11	10,20	4,12	10,18	4,17	10,16	4,21	10,14	4,25	11
12	11,13	4,50	11,11	4,54	11,09	4,59	11,07	4,64	12
13	12,05	4,87	12,03	4,92	12,01	4,97	11,99	5,03	13
14	12,98	5,24	12,96	5,30	12,93	5,36	12,91	5,41	14
15	13,91	5,62	13,88	5,68	13,86	5,74	13,83	5,80	15
16	14,83	5,99	14,81	6,06	14,78	6,12	14,76	6,19	16
17	15,76	6,37	15,73	6,44	15,71	6,51	15,68	6,57	17
18	16,69	6,74	16,66	6,82	10,63	6,89	16,60	6,96	18
19	17,62	7,12	17,59	7,19	17,55	7,27	17,52	7,35	19
20	18,54	7,49	18,51	7,57	18,48	7,65	18,44	7,73	20
21	19.47	7,87	19,44	7,95	19,40	8,04	19,37	8,12	21
22	20,40	8,24	20,36	8,33	20,33	8,42	20,29	8,51	22
23	21,33	8,62	21,29	8,71	21,25	8,80	21,21	8,89	23
24	22,25	8,99	22,21	9,09	22,17	9,18	22,13	9,28	24
25	23,18	9,37	23,14	9,47	23,10	9,57	23,05	9,67	25
26	24,11	9,74	24,06	9,84	24,02	9,95	23,98	10,05	26
27	25,03	10,11	24,99	10,22	24,94	10,33	24,90	10,44	27
28	25,96	10,49	25,92	10,60	25,87	10,72	25,82	10,83	28
29	26,89	10,86	26,84	10,98	20,79	11,10	26,74	11,21	29
30	27,82	11,24	27,77	11,36	27,72	11,48	27.67	11,60	30
31	28,74	11,61	28,69	11,74	28,64	11,86	28,59	11,99	31
32	29,67	11,99	29,62	12,12	29,56	12,25	29,51	12,37	32
33	30,60	12,36	30,54	12,50	30,49	12,63	30,43	12,76	33
34	31,52	12,74	31,47	12,87	31,41	13,01	31,35	13,15	34
35	32,45	13,11	32,39	13,25	32,34	13,39	32,28	13,53	35
36	33,38	13,49	33,32	13,63	33,26	13,78	33,20	13,92	36
37	34.31	13,86	34,24	14,01	34,18	14,16	34,12	14,31	37
38	35,23	14,24	35.17	14,39	35,11	14,54	35,04	14,70	38
39	36,16	14,61	36,10	14,77	36,03	14,92	35,97	15,08	39
40	37,09	14,98	37,02	15,15	30,96	15,31	36,89	15,47	40
41	38,01	15,36	37,95	15,52	37,88	15,69	37,81	15,86	41
42	38,94	15,73	38,87	15,90	38,80	10,07	38,73	16,24	42
43	39,87	16,11	39,80	16,28	39,73	16,46	39,65	16,63	43
44	40,80	16,48	40,72	16,66	40,05	16,84	40,58	17,02	44
45	41,72	16,86	41,65	17,04	41,57	17,22	41,50	17,40	45
46	42,65	17,23	42,57	17,42	42,50	17,60	42,42	17,79	46
47	43,58	17,61	43,50	17,80	43,42	17,99	43,34	18,18	47
48	44,50	17,98	44,43	18,18	44,35	18,37	44,27	18,56	48
49	45,43	18,36	45,35	18.55	45,27	18,75	45,19	18,95	49
50	46,36	18,73	46,28	18,93	46,19	19,13	46,11	19.34	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	68 Deg.		67¾ Deg		67½ Deg.		67¼ Deg.		

Dist.	22 Deg.		22¼ Deg.		22½ Deg.		22¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	47,29	19.10	47.20	19.31	47.12	19.52	47.03	19.72	51
52	48,21	19.48	48.13	19.69	48.04	19.90	47.95	20.11	52
53	49.14	19.85	49.05	20.07	48.97	20.28	48.88	20.50	53
54	50.07	20.25	49.98	20.45	49.89	20.66	49.80	20.88	54
55	51.00	20.60	50.90	20.83	50.81	21.05	50.72	21.27	55
56	51.92	20.98	51.83	21.20	51.74	21.43	51.64	21.66	56
57	52.85	21.35	52.76	21.58	52.66	21.81	52.57	22.04	57
58	53.78	21.73	53.68	21.96	53.59	22.20	53.49	22.43	58
59	54.70	22.10	54.61	22.34	54.51	22.58	54.41	22.82	59
60	55.63	22.48	55.53	22.72	55.43	22.96	55.33	23.20	60
61	56.56	22.85	56.47	23.10	56.36	23.34	56.25	23.59	61
62	57,49	23.23	57.38	23.48	57.28	23.73	57.18	23.98	62
63	58.41	23.60	58.31	23.85	58.20	24.11	58.10	24.36	63
64	59.34	23.97	59.23	24.23	59.13	24.49	59.02	24.75	64
65	60.27	24.35	60.16	24.61	60.05	24.87	59.94	25.14	65
66	61.19	24.72	61.09	24.99	60.98	25.26	60.87	25.52	66
67	62.12	25.10	62.01	25.37	61.90	25.64	61.79	25.91	67
68	63.05	25.47	62.94	25.75	62.82	26.02	62.71	26.30	68
69	63,98	25.85	63.86	26.13	63.75	26.41	63.63	26.68	69
70	64.90	26.22	64.79	26.51	64.67	26.79	64.55	27.07	70
71	65.83	26.00	65.71	26.88	65.60	27.17	65.48	27.46	71
72	66.76	26.97	66.64	27.26	66.52	27.55	66.40	27.84	72
73	67.68	27.25	67.56	27.64	67.44	2 .94	67.32	28.23	73
74	68.61	27.72	68.49	28.02	68.37	28.32	68.24	28.62	74
75	69.54	28.10	69.42	28.40	69.29	28.70	69.17	29.00	75
76	70.47	28.47	70.34	28.78	70.21	29.08	70.09	29.39	76
77	71.39	28.84	71.27	29.16	71.14	29.47	71.01	29.78	77
78	72.32	29.22	72.19	29.53	72.06	29.85	71.93	30.16	78
79	73.25	29.59	73.12	29.91	72.99	30.23	72.85	30.55	79
80	74.17	29.97	74.04	30.29	73.91	30.61	73.78	30.94	80
81	75.10	30.34	74.97	30.67	74.83	31.00	74.70	31.32	81
82	76.03	30.72	75.89	31.05	75.70	31.38	75.62	31.71	82
83	76.96	31.09	76.82	31.43	76.68	31.76	76.54	32.10	83
84	77.88	31.47	77.75	31.81	77.61	32.15	77.46	32.48	84
85	78.81	31.84	78.67	32.19	78.53	32.53	78.39	32.87	85
86	79.74	32.22	79.0	32.56	79.45	32.91	79.31	33.26	86
87	80.66	32.59	80.62	32.94	80.38	33.29	80.23	33.64	87
88	81.59	32.97	81.45	33.32	81.30	33.68	81.15	34.03	88
89	82.52	33.34	82.37	33.70	82.23	34.06	82.06	34.42	89
90	83.45	33.71	83.30	34.06	83.15	34.44	83.00	34.80	90
91	84.37	34.09	84.22	34.46	84.07	34.82	83.92	35.19	91
92	85.30	34.46	85.15	34.84	85.00	35.21	84.84	35.58	92
93	86.23	34.84	86.06	35.21	85.92	35.59	85.70	35.96	93
94	87.10	35.21	87.00	35.59	86.84	35.97	86.69	36.35	94
95	88.08	35.59	87.93	35.97	87.77	36.35	87.61	36.74	95
96	89.01	35.96	88.85	36.35	88.69	36.74	88.53	37.12	96
97	89.94	36.34	89.78	36.73	89.62	37.12	89.45	37.51	97
98	90.86	36.71	90.70	37.11	90.54	37.50	90.38	37.90	98
99	91.79	37.09	91.63	37.49	91.46	37.89	91.30	38.28	99
100	92.74	37.46	92.55	37.86	92.39	38.27	92.22	38.67	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	68 Deg.		67¾ Deg		67½ Deg.		67¼ Deg.		

Dist.	23 Deg.		23¼ Deg.		23½ Deg.		23¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.92	0.39	0.92	0.39	0.92	0.40	0.92	0.40	1
2	1.84	0.78	1.84	0.79	1.83	0.80	1.83	0.81	2
3	2.76	1.17	2.76	1.18	2.75	1.20	2.75	1.21	3
4	3.68	1.56	3.68	1.58	3.67	1.59	3.66	1.61	4
5	4.60	1.95	4.59	1.97	4.59	1.99	4.58	2.01	5
6	5.52	2.34	5.51	2.37	5.50	2.39	5.49	2.42	6
7	6.44	2.74	6.43	2.76	6.42	2.79	6.41	2.82	7
8	7.36	3.13	7.35	3.16	7.34	3.19	7.32	3.22	8
9	8.28	3.52	8.27	3.55	8.25	3.59	8.24	3.62	9
10	9.20	3.91	9.19	3.95	9.17	3.99	9.15	4.03	10
11	10.13	4.30	10.11	4.34	10.09	4.39	10.07	4.43	11
12	11.05	4.69	11.03	4.74	11.00	4.78	10.98	4.83	12
13	11.97	5.08	11.94	5.13	11.92	5.18	11.90	5.24	13
14	12.89	5.47	12.86	5.53	12.84	5.58	12.81	5.64	14
15	13.81	5.86	13.78	5.92	13.76	5.98	13.73	6.04	15
16	14.73	6.25	14.70	6.32	14.67	6.38	14.64	6.44	16
17	15.05	6.64	15.62	6.71	15.59	6.78	15.56	6.85	17
18	10.57	7.03	16.54	7.11	16.51	7.18	16.48	7.25	18
19	17.49	7.42	17.46	7.50	17.42	7.58	17.39	7.65	19
20	18.41	7.81	18.38	7.89	18.34	7.97	18.31	8.05	20
21	19.33	8.21	19.29	8.29	19.26	8.37	19.22	8.46	21
22	20.25	8.60	20.21	8.68	20.18	8.77	20.14	8.86	22
23	21.17	8.99	21.13	9.08	21.09	9.17	21.05	9.26	23
24	22.09	9.38	22.05	9.47	22.01	9.57	21.97	9.67	24
25	23.01	9.77	22.97	9.87	22.93	9.97	22.88	10.07	25
26	23.93	10.16	23.89	10.26	23.84	10.37	23.80	10.47	26
27	24.85	10.55	24.81	10.66	24.76	10.77	24.71	10.87	27
28	25.77	10.94	25.73	11.05	25.68	11.16	25.63	11.28	28
29	26.69	11.33	20.64	11.45	26.59	11.56	26.54	11.68	29
30	27.62	11.72	27.56	11.84	27.51	11.96	27.46	12.08	30
31	28.54	12.11	28.48	12.24	28.43	12.36	28.37	12.49	31
32	29.46	12.50	29.40	12.63	29.35	12.76	29.29	12.89	32
33	30.38	12.89	30.32	13.03	30.26	13.16	30.21	13.29	33
34	31.30	13.28	31.24	13.42	31.18	13.56	31.12	13.69	34
35	32.22	13.68	32.16	13.82	32.10	13.96	32.04	14.10	35
36	33.14	14.07	33.08	14.21	33.01	14.35	32.95	14.50	36
37	34.06	14.46	34.00	14.01	33.93	14.75	33.87	14.90	37
38	34.98	14.85	34.91	15.00	34.85	15.15	34.78	15.30	38
39	35.90	15.24	35.83	15.39	35.77	15.55	35.70	15.71	39
40	36.82	15.63	36.75	15.79	36.68	15.95	36.61	16.11	40
41	37.74	16.02	37.67	16.18	37.60	16.35	37.53	16.51	41
42	38.66	16.41	38.59	16.58	38.52	16.75	38.44	16.92	42
43	39.58	16.80	39.51	16.97	39.43	17.15	39.36	17.32	43
44	40.50	17.19	40.43	17.37	40.35	17.54	40.27	17.72	44
45	41.42	17.58	41.35	17.76	41.27	17.94	41.19	18.12	45
46	42.34	17.97	42.26	18.16	42.18	18.34	42.10	18.53	46
47	43.26	18.36	43.18	18.55	43.10	18.74	43.02	18.93	47
48	44.18	18.76	44.10	18.95	44.02	19.14	43.93	19.33	48
49	45.10	19.15	45.02	19.34	44.94	19.54	44.85	19.73	49
50	46.03	19.54	45.94	19.74	45.85	19.94	45.77	20.14	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	67 Deg.		66¾ Deg.		66½ Deg.		66¼ Deg		

Dist.	23 Deg.		23¼ Deg.		23½ Deg.		23¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	46.95	19.93	46.86	20.13	46.77	20.34	46.68	20.54	51
52	47.87	20.32	47.78	20.53	47.69	20.73	47.60	20.94	52
53	48.79	20.71	48.70	20.92	48.60	21.13	48.51	21.35	53
54	49.71	21.10	49.61	21.32	49.52	21.53	49.43	21.75	54
55	50.63	21.49	50.53	21.71	50.44	21.93	50.34	22.15	55
56	51.55	21.88	51.45	22.11	51.36	22.33	51.26	22.55	56
57	52.47	22.27	52.37	22.50	52.27	22.73	52.17	22.96	57
58	53.39	22.66	53.29	22.90	53.19	23.13	53.09	23.36	58
59	54.31	23.05	54.21	23.29	54.11	23.53	54.00	23.76	59
60	55.23	23.44	55.13	23.68	55.02	23.92	54.92	24.16	60
61	56.15	23.83	56.05	24.08	55.94	24.32	55.83	24.57	61
62	57.07	24.23	56.97	24.47	56.86	24.72	56.75	24.97	62
63	57.99	24.62	57.88	24.87	57.77	25.12	57.66	25.37	63
64	58.91	25.01	58.80	25.26	58.69	25.52	58.58	25.78	64
65	59.83	25.40	59.72	25.66	59.61	25.92	59.50	26.18	65
66	60.75	25.79	60.64	26.05	60.53	26.32	60.41	26.58	66
67	61.67	26.18	61.56	26.45	61.44	26.72	61.33	26.98	67
68	62.59	26.57	62.48	26.84	62.36	27.11	62.24	27.39	68
69	63.51	26.96	63.40	27.24	63.26	27.51	63.16	27.79	69
70	64.44	27.35	64.32	27.63	64.19	27.91	64.07	28.19	70
71	65.36	27.74	65.23	28.03	65.11	28.31	64.99	28.59	71
72	66.28	28.13	66.15	28.42	66.03	28.71	65.90	29.00	72
73	67.20	28.52	67.07	28.82	66.95	29.11	66.82	29.40	73
74	68.12	28.91	67.99	29.21	67.86	29.51	67.73	29.80	74
75	69.04	29.30	68.91	29.61	68.78	29.91	68.65	30.21	75
76	69.96	29.70	69.83	30.00	69.70	30.30	69.56	30.61	76
77	70.88	30.09	70.75	30.40	70.61	30.70	70.48	31.01	77
78	71.80	30.48	71.67	30.79	71.53	31.10	71.39	31.41	78
79	72.72	30.87	72.58	31.18	72.45	31.50	72.31	31.82	79
80	73.64	31.26	73.50	31.58	73.36	31.90	73.22	32.22	80
81	74.56	31.65	74.42	31.97	74.28	32.30	74.14	32.62	81
82	75.48	32.04	75.34	32.37	75.20	32.70	75.06	33.03	82
83	76.40	32.43	76.26	32.76	76.12	33.10	75.97	33.43	83
84	77.32	32.82	77.18	33.16	77.03	33.49	76.89	33.83	84
85	78.24	33.21	78.10	33.55	77.95	33.89	77.80	34.23	85
86	79.16	33.60	79.02	33.95	78.87	34.29	78.72	34.64	86
87	80.08	33.99	79.94	34.34	79.78	34.69	79.63	35.04	87
88	81.00	34.38	80.85	34.74	80.70	35.09	80.55	35.44	88
89	81.92	34.76	81.77	35.13	81.62	35.49	81.46	35.84	89
90	82.85	35.17	82.69	35.53	82.54	35.89	82.38	36.25	90
91	83.77	35.56	83.61	35.92	83.45	36.29	83.29	36.65	91
92	84.69	35.95	84.53	36.32	84.37	36.68	84.21	37.05	92
93	85.61	36.34	85.45	36.71	85.29	37.08	85.12	37.46	93
94	86.53	36.73	86.37	37.11	86.20	37.48	86.04	37.86	94
95	87.45	37.12	87.29	37.50	87.12	37.88	86.95	38.26	95
96	88.37	37.51	88.20	37.90	88.04	38.28	87.87	38.66	96
97	89.29	37.90	89.12	38.29	88.95	38.68	88.79	39.07	97
98	90.21	38.29	90.04	38.68	89.87	39.08	89.70	39.47	98
99	91.13	38.68	90.96	39.08	90.79	39.48	90.62	39.87	99
100	92.05	39.07	91.88	39.47	91.71	39.87	91.53	40.27	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	67 Deg.		66¾ Deg.		66½ Deg.		66¼ Deg.		

Dist.	24 Deg.		24¼ Deg.		24½ Deg.		24¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,91	0,41	0,91	0,41	0,91	0,41	0,91	0,42	1
2	1,83	0,81	1,82	0,82	1,82	0,83	1,82	0,84	2
3	2,74	1,22	2,74	1,23	2,73	1,24	2,72	1,26	3
4	3,65	1,63	3,65	1,64	3,64	1,66	3,63	1,67	4
5	4,57	2,03	4,56	2,05	4,55	2,07	4,54	2,09	5
6	5,48	2,44	5,47	2,46	5,46	2,49	5,45	2,51	6
7	6,39	2,85	6,38	2,87	6,37	2,90	6,36	2,93	7
8	7,31	3,25	7,29	3,29	7,28	3,32	7,27	3,35	8
9	8,22	3,66	8,21	3,70	8,19	3,73	8,17	3,77	9
10	9,14	4,07	9,12	4,11	9,10	4,15	9,08	4,19	10
11	10,05	4,47	10,03	4,52	10,01	4,56	9,99	4,61	11
12	10,96	4,88	10,94	4,93	10,92	4,98	10,90	5,02	12
13	11,88	5,29	11,85	5,34	11,83	5,39	11,81	5,44	13
14	12,79	5,69	12,76	5,75	12,74	5,81	12,71	5,86	14
15	13,70	6,10	13,68	6,16	13,65	6,22	13,62	6,28	15
16	14,62	6,51	14,59	6,57	14,56	6,64	14,53	6,70	16
17	15,53	6,92	15,50	6,98	15,47	7,05	15,44	7,12	17
18	16,44	7,32	16,41	7,39	16,38	7,46	16,35	7,54	18
19	17,36	7,73	17,32	7,80	17,29	7,88	17,25	7,95	19
20	18,27	8,13	18,24	8,21	18,20	8,29	18,16	8,37	20
21	19.18	8 54	19,15	8,63	19,11	8,71	19,07	8,79	21
22	20,10	8,95	20,06	9,04	20,02	9,12	19,98	9,21	22
23	21,01	9,35	20,97	9,45	20,93	9,54	20,89	9,63	23
24	21,93	9,76	21,88	9,86	21,84	9,95	21,80	10,05	24
25	22,84	10,17	22,79	10,27	22,75	10,37	22,70	10,47	25
26	23,75	10,58	23,71	10,68	23,06	10,78	23,61	10,89	26
27	24,67	10,98	24,02	11,09	24,57	11,20	24,52	11,30	27
28	25,58	11,39	25,53	11,50	25,48	11,61	25,43	11,72	28
29	26,49	11,80	26,44	11,91	26,39	12,03	26,34	12,14	29
30	27,41	12,20	27,35	12,32	27,30	12,44	27.24	12,56	30
31	28,32	12,61	28,26	12,73	28,21	12,86	28,15	12,98	31
32	29,23	13,02	29,18	13,14	29,12	13,27	29,06	13,40	32
33	30,15	13,42	30,09	13,55	30,03	13,68	29,97	13,82	33
34	31,06	13,83	31,00	13,96	30,94	14,10	30,88	14,23	34
35	31,97	14,24	31,91	14,38	31,85	14,51	31,78	14,65	35
36	32,89	14,64	32,82	14,79	32,76	14,93	32,69	15,07	36
37	33,80	15,05	33,74	15,20	33,67	15,34	33,60	15,49	37
38	34.71	15,46	34,65	15,61	34,58	15,76	34,51	15,91	38
39	35,63	15,86	35.56	16,02	35,49	16,17	35,42	16,33	39
40	36,54	16,27	36,47	16,43	36,40	16,59	36,33	16,75	40
41	37,46	16,68	37,38	16,84	37,31	17,00	37,23	17,16	41
42	38,37	17,08	38,29	17,25	38,22	17,42	38,14	17,58	42
43	39,28	17,49	39,21	17,66	39,13	17,83	39,05	18,00	43
44	40,20	17,90	40,12	18,07	40,04	18,25	39,96	18,42	44
45	41,11	18,30	41,03	18,48	40,95	18,00	40,87	18,84	45
46	42,02	18,71	41,94	18,89	41,60	19,08	41,77	19.26	46
47	42,94	19,12	42,85	19,30	42,77	19,49	42,68	19,68	47
48	43,85	19,52	43,76	19,71	43,68	19,91	43,59	20,10	48
49	44,76	19,93	44.68	20,13	44,59	20,32	44,50	20,51	49
50	45,68	20,34	45,59	20 54	45,50	20,73	45,41	20,93	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	66 Deg.		65¾ Deg		65½ Deg.		65¼ Deg.		Dist.

Diſt.	24 Deg		24¼ Deg.		24½ Deg.		24¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	46.59	20.74	46.50	20.95	46.41	21.15	46.32	21.35	51
52	47.50	21.15	47.41	21.36	47.32	21.56	47.22	21.77	52
53	48.42	21.56	48.32	21.77	48.23	21.98	48.13	22.19	53
54	49.33	21.96	49.24	22.18	49.14	22.39	49.04	22.61	54
55	50.24	22.37	50.15	22.59	50.05	22.81	49.95	23.03	55
56	51.16	22.78	51.06	23.00	50.96	23.22	50.86	23.44	56
57	52.07	23.18	51.97	23.41	51.87	23.64	51.76	23.86	57
58	52.99	23.59	52.88	23.82	52.78	24.05	52.67	24.28	58
59	53.90	24.00	53.79	24.23	53.69	24.47	53.58	24.70	59
60	54.81	24.40	54.71	24.64	54.60	24.88	54.49	25.12	60
61	55.73	24.81	55.62	25.05	55.51	25.30	55.40	25.54	61
62	56.64	25.22	56.53	25.46	56.42	25.71	56.30	25.96	62
63	57.55	25.62	57.44	25.88	57.33	26.13	57.21	26.38	63
64	58.47	26.03	58.35	26.29	58.24	26.54	58.12	26.79	64
65	59.38	26.44	59.26	26.70	59.15	26.96	59.03	27.21	65
66	60.29	26.84	60.18	27.11	60.06	27.37	59.94	27.63	66
67	61.21	27.25	61.09	27.52	60.97	27.78	60.85	28.05	67
68	62.12	27.66	62.00	27.93	61.88	28.20	61.75	28.47	68
69	63.03	28.06	62.91	28.34	62.79	28.61	62.66	28.89	69
70	63.95	28.47	63.82	28.75	63.70	29.03	63.57	29.31	70
71	64.86	28.88	64.74	29.16	64.61	29.44	64.48	29.72	71
72	65.78	29.28	65.65	29.57	65.52	29.86	65.39	30.14	72
73	66.69	29.69	66.56	29.98	66.43	30.27	66.29	30.56	73
74	67.60	30.10	67.47	30.39	67.34	30.69	67.20	30.98	74
75	68.52	30.51	68.38	30.80	68.25	31.10	68.11	31.40	75
76	69.43	30.91	69.29	31.21	69.16	31.52	69.02	31.82	76
77	70.34	31.32	70.21	31.63	70.07	31.93	69.93	32.24	77
78	71.26	31.73	71.12	32.04	70.98	32.35	70.84	32.66	78
79	72.17	32.13	72.03	32.45	71.89	32.76	71.74	33.07	79
80	73.08	32.54	72.94	32.86	72.80	33.18	72.65	33.49	80
81	74.00	32.95	73.85	33.27	73.71	33.59	73.56	33.91	81
82	74.91	33.35	74.76	33.68	74.62	34.00	74.47	34.33	82
83	75.82	33.76	75.68	34.09	75.53	34.42	75.38	34.75	83
84	76.74	34.17	76.59	34.50	76.44	34.83	76.28	35.17	84
85	77.65	34.57	77.50	34.91	77.35	35.25	77.19	35.59	85
86	78.56	34.98	78.41	35.32	78.26	35.66	78.10	36.00	86
87	79.48	35.39	79.32	35.73	79.17	36.08	79.01	36.42	87
88	80.39	35.79	80.24	36.14	80.08	36.49	79.92	36.84	88
89	81.31	36.20	81.15	36.55	80.99	36.91	80.82	37.26	89
90	82.22	36.61	82.06	36.96	81.90	37.32	81.73	37.68	90
91	83.13	37.01	82.97	37.38	82.81	37.74	82.64	38.10	91
92	84.05	37.42	83.88	37.79	83.72	38.15	83.55	38.52	92
93	84.96	37.83	84.79	38.20	84.63	38.57	84.46	38.94	93
94	85.87	38.23	85.71	38.61	85.54	38.98	85.37	39.35	94
95	86.79	38.64	86.62	39.02	86.45	39.40	86.27	39.77	95
96	87.70	39.05	87.53	39.43	87.36	39.81	87.18	40.19	96
97	88.61	39.45	88.44	39.84	88.27	40.23	88.09	40.61	97
98	89.53	39.86	89.35	40.25	89.18	40.64	89.00	41.03	98
99	90.44	40.27	90.26	40.66	90.09	41.05	89.91	41.45	99
100	91.35	40.67	91.18	41.07	91.00	41.47	90.81	41.87	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	66 Deg.		65¾ Deg.		65½ Deg.		65¼ Deg.		

Dist.	25 Deg.		25¼ Deg		25½ Deg.		25¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.91	0.42	0.90	0.43	0.90	0.43	0.90	0.43	1
2	1.81	0.85	1.81	0.85	1.81	0.86	1.80	0.87	2
3	2.72	1.27	2.71	1.28	2.71	1.29	2.70	1.30	3
4	3.63	1.69	3.62	1.71	3.6	1.72	3.60	1.74	4
5	4.53	2.11	4.52	2.13	4.5	2.15	4.50	2.17	5
6	5.44	2.54	5.43	2.56	5.42	2.58	5.40	2.61	6
7	6.34	2.96	6.33	2.99	6.32	3.01	6.30	3.04	7
8	7.25	3.38	7.24	3.41	7.22	3.44	7.21	3.48	8
9	8.16	3.80	8.14	3.84	8.12	3.87	8.11	3.91	9
10	9.06	4.23	9.04	4.27	9.03	4.31	9.01	4.34	10
11	9.97	4.65	9.95	4.69	9.93	4.74	9.91	4.78	11
12	10.88	5.07	10.85	5.12	10.83	5.17	10.81	5.21	12
13	11.78	5.49	11.70	5.55	11.73	5.60	11.71	5.95	13
14	12.69	5.92	12.66	5.97	12.04	6.03	12.61	6.08	14
15	13.59	6.34	3.57	6.40	13.54	6.46	13.51	6.52	15
16	14.50	6.76	4.47	6.83	14.44	6.89	14.41	6.95	16
17	15.41	7.18	15.38	7.25	15.34	7.32	15.31	7.39	17
18	16.31	7.61	16.28	7.68	16.24	7.75	16.21	7.82	18
19	17.22	8.03	17.18	8.10	17.15	8.18	17.11	8.25	19
20	18.13	8.45	18.09	8.53	18.05	8.61	18.01	8.69	20
21	19.03	8.87	18.99	8.96	18.95	9.04	18.91	9.12	21
22	19.94	9.30	19.90	9.38	19.86	9.47	19.82	9.56	22
23	20.85	9.72	20.80	9.81	20.76	9.90	20.72	9.99	23
24	21.75	10.14	21.71	10.24	21.66	10.33	21.62	10.43	24
25	22.66	10.57	22.61	10.66	22.56	10.76	22.52	10.86	25
26	23.56	10.99	23.52	11.09	23.47	11.19	23.42	11.30	26
27	24.47	11.41	24.42	11.52	24.37	11.62	24.32	11.73	27
28	25.38	11.83	25.32	11.94	25.27	12.05	25.22	12.16	28
29	26.28	12.26	26.23	12.37	26.1	12.48	26.12	12.60	29
30	27.19	12.68	27.13	12.80	27.08	12.92	27.02	13.03	30
31	28.10	13.10	28.04	13.22	27.98	13.35	27.92	13.47	31
32	29.00	13.52	28.94	13.65	28.88	13.78	28.82	13.90	32
33	29.91	13.95	29.85	14.08	29.79	14.21	29.72	14.34	33
34	30.81	14.37	30.75	14.50	30.69	14.64	30.62	14.77	34
35	31.72	14.79	31.66	14.93	31.59	15.07	31.52	15.21	35
36	32.63	15.21	32.56	15.36	32.49	15.50	32.43	15.64	36
37	33.53	15.64	33.46	15.78	33.40	15.93	33.33	16.07	37
38	34.44	16.06	34.37	16.21	34.30	16.36	34.23	16.51	38
39	35.35	16.48	35.27	16.64	35.20	16.79	35.13	16.94	39
40	36.25	16.90	36.18	17.06	36.10	17.22	36.03	17.38	40
41	37.16	17.33	37.08	17.49	37.01	17.65	36.93	17.81	41
42	38.06	17.75	37.99	17.92	37.91	18.08	37.83	18.25	42
43	38.97	18.17	38.89	18.34	38.81	18.51	38.73	18.68	43
44	39.88	18.60	39.80	18.77	39.71	18.94	39.63	19.12	44
45	40.78	19.02	40.70	19.20	40.62	19.37	40.53	19.55	45
46	41.69	19.44	41.60	19.62	41.52	19.80	41.43	19.98	46
47	42.60	19.86	42.51	20.05	42.42	20.23	42.33	20.42	47
48	43.50	20.29	43.41	20.48	43.32	20.66	43.23	20.85	48
49	44.41	20.71	44.32	20.90	44.23	21.10	44.13	21.29	49
50	45.32	21.13	45.22	21.33	45.13	21.53	45.03	21.72	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	65 Deg.		64¾ Deg.		64½ Deg.		64¼ Deg.		

Diſt.	25 Deg		25¼ Deg		25½ Deg.		25¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	46.22	21.55	46.13	21.75	46.03	21.96	45.94	22.16	51
52	47.13	21.98	47.03	22.18	46.93	22.39	46.84	22.59	52
53	48.03	22.40	47.94	22.61	47.84	22.82	47.74	23.03	53
54	48.94	22.82	48.84	23.03	48.74	23.25	48.64	23.46	54
55	49.85	23.24	49.74	23.46	49.64	23.68	49.54	23.89	55
56	50.75	23.67	50.65	23.89	50.54	24.11	50.44	24.33	56
57	51.66	24.09	51.55	24.31	51.45	24.54	51.34	24.76	57
58	52.57	24.51	52.46	24.74	52.35	24.97	52.24	25.20	58
59	53.47	24.93	53.36	25.17	53.25	25.40	53.14	25.63	59
60	54.38	25.36	54.27	25.59	54.16	25.83	54.04	26.07	60
61	55.28	25.78	55.17	26.02	55.06	26.26	54.94	26.50	61
62	56.19	26.20	56.08	26.45	55.96	26.69	55.84	26.94	62
63	57.10	26.62	56.98	26.87	56.86	27.12	56.74	27.37	63
64	58.00	27.05	57.89	27.30	57.77	27.55	57.64	27.80	64
65	58.91	27.47	58.79	27.73	58.67	27.98	58.55	28.24	65
66	59.82	27.89	59.69	28.15	59.57	28.41	59.45	28.67	66
67	60.72	28.32	60.60	28.58	60.47	28.84	60.35	29.11	67
68	61.63	28.74	61.50	29.01	61.38	29.27	61.25	29.54	68
69	62.54	29.16	62.41	29.43	62.28	29.71	62.15	29.98	69
70	63.44	29.58	63.31	29.86	63.18	30.14	63.05	30.41	70
71	64.35	30.01	64.22	30.29	64.08	30.57	63.95	30.85	71
72	65.25	30.43	65.12	30.71	64.99	31.00	64.85	31.28	72
73	66.16	30.85	66.03	31.14	65.89	31.43	65.75	31.71	73
74	67.07	31.27	66.93	31.57	66.79	31.86	66.65	32.15	74
75	67.97	31.70	67.83	31.99	67.69	32.29	67.55	32.58	75
76	68.88	32.12	68.74	32.42	68.60	32.72	68.45	33.02	76
77	69.79	32.54	69.64	32.85	69.50	33.15	69.35	33.45	77
78	70.69	32.96	70.55	33.27	70.40	33.58	70.25	33.89	78
79	71.60	33.39	71.45	33.70	71.30	34.01	71.16	34.32	79
80	72.50	33.81	72.36	34.13	72.21	34.44	72.06	34.76	80
81	73.41	34.23	73.26	34.55	73.11	34.87	72.96	35.19	81
82	74.32	34.65	74.17	34.98	74.01	35.30	73.86	35.62	82
83	75.22	35.08	75.07	35.41	74.91	35.73	74.76	36.06	83
84	76.13	35.50	75.97	35.83	75.82	36.16	75.66	36.49	84
85	77.04	35.92	76.88	36.26	76.72	36.59	76.56	36.93	85
86	77.94	36.35	77.78	36.68	77.62	37.02	77.46	37.36	86
87	78.85	36.77	78.69	37.11	78.52	37.45	78.36	37.80	87
88	79.76	37.19	79.59	37.54	79.43	37.88	79.26	38.23	88
89	80.66	37.61	80.50	37.96	80.33	38.32	80.16	38.67	89
90	81.57	38.04	81.40	38.39	81.23	38.75	81.06	39.10	90
91	82.47	38.46	82.31	38.82	82.14	39.18	81.96	39.53	91
92	83.38	38.88	83.21	39.24	83.04	39.61	82.86	39.97	92
93	84.29	39.30	84.11	39.67	83.94	40.04	83.76	40.40	93
94	85.19	39.73	85.02	40.10	84.84	40.47	84.67	40.84	94
95	86.10	40.15	85.92	40.52	85.75	40.90	85.57	41.27	95
96	87.01	40.57	86.83	40.95	86.65	41.33	86.47	41.71	96
97	87.91	40.99	87.73	41.38	87.55	41.76	87.37	42.14	97
98	88.82	41.42	88.64	41.80	88.45	42.19	88.27	42.58	98
99	89.72	41.84	89.54	42.23	89.36	42.62	89.17	43.01	99
100	90.63	42.26	90.45	42.60	90.26	43.05	90.07	43.44	100
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	65 Deg.		64¾ Deg.		64½ Deg.		64¼ Deg.		

Dist.	26 Deg.		26¼ Deg.		26½ Deg.		26¾ Deg.		Dist.
	Lat.	Dep.	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.90	0.44	0.90	0.44	0.89	0.45	0.89	0.45	1
2	1.80	0.88	1.79	0.88	1.79	0.89	1.79	0.90	2
3	2.70	1.32	2.69	1.33	2.68	1.34	2.68	1.35	3
4	3.60	1.75	3.59	1.77	3.58	1.78	3.57	1.80	4
5	4.49	2.19	4.48	2.21	4.47	2.23	4.46	2.25	5
6	5.39	2.63	5.38	2.05	5.37	2.68	5.36	2.70	6
7	6.29	3.07	6.28	3.10	6.26	3.12	6.25	3.15	7
8	7.19	3.51	7.17	3.54	7.16	3.57	7.14	3.60	8
9	8.09	3.95	8.07	3.98	8.05	4.02	8.04	4.05	9
10	8.99	4.38	8.97	4.42	8.95	4.46	8.93	4.50	10
11	9.89	4.82	9.87	4.87	9.84	4.91	9.82	4.95	11
12	10.79	5.26	10.76	5.31	10.74	5.35	10.72	5.40	12
13	11.68	5.70	11.66	5.75	11.63	5.80	11.61	5.85	13
14	12.58	6.14	12.56	6.19	12.53	6.25	12.50	6.30	14
15	13.48	6.58	13.45	6.63	13.42	6.69	13.39	6.75	15
16	14.38	7.01	14.35	7.08	14.32	7.14	14.29	7.20	16
17	15.28	7.45	15.25	7.52	15.21	7.59	15.18	7.65	17
18	16.18	7.89	16.14	7.96	16.11	8.03	16.07	8.10	18
19	17.08	8.33	17.04	8.40	17.00	8.48	16.97	8.55	19
20	17.98	8.77	17.94	8.85	17.90	8.92	17.86	9.00	20
21	18.87	9.21	18.83	9.29	18.79	9.37	18.75	9.45	21
22	19.77	9.64	19.73	9.73	19.69	9.82	19.65	9.90	22
23	20.67	10.08	20.63	10.17	20.58	10.26	20.54	10.35	23
24	21.57	10.52	21.52	10.61	21.48	10.71	21.43	10.80	24
25	22.47	10.96	22.42	11.06	22.37	11.15	22.32	11.25	25
26	23.37	11.40	23.32	11.50	23.27	11.60	23.22	11.70	26
27	24.27	11.84	24.22	11.94	24.16	12.05	24.11	12.15	27
28	25.17	12.27	25.11	12.38	25.06	12.49	25.00	12.60	28
29	26.06	12.71	26.01	12.83	25.95	12.94	25.90	13.05	29
30	26.96	13.15	26.91	13.27	26.85	13.39	26.79	13.50	30
31	27.86	13.59	27.80	13.71	27.74	13.83	27.68	13.95	31
32	28.76	14.03	28.70	14.15	28.64	14.28	28.58	14.40	32
33	29.66	14.47	29.60	14.60	29.53	14.72	29.47	14.85	33
34	30.56	14.90	30.49	15.04	30.43	15.17	30.36	15.30	34
35	31.46	15.34	31.39	15.48	31.32	15.62	31.25	15.75	35
36	32.36	15.78	32.29	15.92	32.22	16.06	32.15	16.20	36
37	33.26	16.22	33.18	16.36	33.11	16.51	33.04	16.65	37
38	34.15	16.66	34.08	16.81	34.01	16.96	33.93	17.10	38
39	35.05	17.10	34.98	17.25	34.90	17.40	34.83	17.55	39
40	35.95	17.53	35.87	17.69	35.80	17.85	35.72	18.00	40
41	36.85	17.97	36.77	18.13	36.69	18.29	36.61	18.45	41
42	37.75	18.41	37.67	18.58	37.59	18.74	37.51	18.90	42
43	38.65	18.85	38.57	19.02	38.48	19.19	38.40	19.35	43
44	39.55	19.29	39.46	19.46	39.38	19.63	39.29	19.80	44
45	40.45	19.73	40.36	19.90	40.27	20.08	40.18	20.25	45
46	41.34	20.17	41.26	20.35	41.17	20.53	41.08	20.70	46
47	42.24	20.60	42.15	20.79	42.06	20.97	41.97	21.15	47
48	43.14	21.04	43.05	21.23	42.96	21.42	42.86	21.60	48
49	44.04	21.48	43.95	21.67	43.85	21.86	43.76	22.05	49
50	44.94	21.92	44.84	22.11	44.75	22.31	44.65	22.50	50
Dist.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	64 Deg.		63¾ Deg.		63½ Deg.		63¼ Deg.		

Diſt.	26 Deg. Lat.	26 Deg. Dep.	26¼ Deg. Lat.	26¼ Deg. Dep.	26½ Deg. Lat.	26½ Deg. Dep.	26¾ Deg. Lat.	26¾ Deg. Dep.	Diſt.
51	45.84	22,36	45,74	22,56	45,64	22,76	45,54	22,95	51
52	46,74	22,80	46,64	23,00	46,54	23,20	46,43	23,41	52
53	47,64	23,23	47,53	23,44	47,43	23,65	47,33	23,86	53
54	48,53	23,67	48,43	23,88	48,33	24,09	48,22	24,31	54
55	49,43	24,11	49,33	24,33	49,22	24,54	49,11	24,76	55
56	50,33	24,55	50,22	24,77	50,12	24,99	50,01	25,21	56
57	51,23	24,99	51,12	25,21	51,01	25,43	50,90	25,66	57
58	52,13	25,43	52,02	25,65	51,91	25,88	51,79	26,11	58
59	53,03	25,86	52,92	26,09	52,80	26,33	52,69	26,56	59
60	53,93	26,30	53,81	26,54	53,70	26,77	53,58	27,01	60
61	54,83	26,74	54,71	26,98	54,59	27,22	54,47	27,46	61
62	55,73	27,18	55,61	27,42	55,49	27,66	55,36	27,91	62
63	56,62	27,62	56,50	27,86	56,38	28,11	56,26	28,36	63
64	57,52	28,06	57,40	28,31	57,28	28,56	57,15	28,81	64
65	58,42	28,49	58,30	28,75	58,17	29,00	58,04	29,26	65
66	59,32	28,93	59,19	29,19	59,06	29,45	58,94	29,71	66
67	60,22	29,37	60,09	29,63	59,96	29,90	59,83	30,16	67
68	61,12	29,81	60,99	30,08	60,86	30,34	60,72	30,61	68
69	62,02	30,25	61,88	30,52	61,75	30,79	61,62	31,06	69
70	62.92	30,69	62,78	30,96	62,65	31,23	62,51	31,51	70
71	63,81	31,12	63,68	31,40	63,54	31,68	63,40	31,96	71
72	64,71	31,56	64,57	31,84	64,44	32,13	64,29	32,41	72
73	65,61	32,00	65,47	32,29	65,33	32,57	65,19	32,86	73
74	66,51	32,44	66,37	32,73	66,23	33,02	66,08	33,31	74
75	67,41	32,88	67,27	33,17	67,12	33,46	66,97	33,76	75
76	68,31	33,32	68,16	33,61	68,01	33,91	67,87	34,21	76
77	69,21	33,75	69,06	34,06	68,91	34,36	68,76	34,66	77
78	70,11	34,19	69,96	34,50	69,80	34,80	69,65	35,11	78
79	71,00	34,63	70,85	34,94	70,70	35,25	70,55	35,56	79
80	71.90	35,07	71,75	35,38	71,59	35,70	71,44	36,01	80
81	72,8	35,51	72,65	35,83	72,49	36,14	72,33	36,46	81
82	73,70	35,95	73,54	36,27	73,38	36,59	73,22	36,91	82
83	74,60	36,38	74,44	36,71	74,28	37,03	74,12	37,36	83
84	75,50	36,82	75,34	37,15	75,17	37,48	75,01	37,81	84
85	76,40	37,26	76,23	37,59	76,07	37,93	75,90	38,26	85
86	77,30	37,70	77,13	38,04	76,96	38,37	76,80	38,71	86
87	78,20	38,14	78,03	38,48	77,86	38,82	77,69	39,16	87
88	79,09	38,58	78,92	38,92	78,75	39,27	78,58	39,61	88
89	79,99	39,01	79,82	39,36	79,65	39,71	79,48	40,06	89
90	80,89	39,45	80,72	39,81	80,54	40,16	80,37	40,51	90
91	81,79	39,89	81,62	40,25	81,44	40,60	81,26	40,96	91
92	82,69	40,33	82,51	40,69	82,33	41,05	82,15	41,41	92
93	83,59	40,77	83,41	41,13	83,23	41,50	83,05	41,86	93
94	84,49	41,21	84,31	41,58	84,12	41,94	83,94	42,31	94
95	85,39	41,65	85,20	42,02	85,02	42,39	84,83	42,76	95
96	86,28	42,08	86,10	42,46	85,91	42,83	85,73	43,21	96
97	87,18	42,52	87,00	42,90	86,81	43,28	86,62	43,66	97
98	88,08	42,96	87,89	43,34	87,70	43,73	87,51	44,11	98
99	88.98	43,40	88,79	43,79	88,60	44,17	88,40	44,56	99
100	89,88	43,84	89,69	44,23	89,49	44,62	89,30	45,01	100
Diſt.	64 Deg. Dep.	64 Deg. Lat.	63¾ Deg. Dep.	63¾ Deg. Lat.	63½ Deg. Dep.	63½ Deg. Lat.	63¼ Deg. Dep.	63¼ Deg. Lat.	Diſt.

Dist.	27 Deg.		27¼ Deg.		27½ Deg.		27¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.89	0.45	0.89	0.46	0.89	0.46	0.88	0.47	1
2	1.78	0.91	1.78	0.92	1.77	0.92	1.77	0.93	2
3	2.67	1.36	2.67	1.37	2.66	1.39	2.65	1.40	3
4	3.56	1.82	3.56	1.83	3.55	1.85	3.54	1.86	4
5	4.45	2.27	4.45	2.29	4.44	2.31	4.42	2.33	5
6	5.35	2.72	5.33	2.75	5.32	2.77	5.31	2.79	6
7	6.24	3.18	6.22	3.21	6.21	3.23	6.19	3.26	7
8	7.13	3.63	7.11	3.66	7.10	3.69	7.08	3.72	8
9	8.02	4.09	8.00	4.12	7.98	4.16	7.96	4.19	9
10	8.91	4.54	8.89	4.58	8.87	4.62	8.85	4.66	10
11	9.80	4.99	9.78	5.04	9.76	5.08	9.73	5.12	11
12	10.69	5.45	10.67	5.49	10.64	5.54	10.62	5.59	12
13	11.58	5.90	11.56	5.95	11.53	6.00	11.50	6.05	13
14	12.47	6.36	12.45	6.41	12.42	6.46	12.39	6.52	14
15	13.37	6.81	13.34	6.87	13.31	6.93	13.27	6.98	15
16	14.26	7.26	14.22	7.33	14.19	7.39	14.16	7.45	16
17	15.15	7.72	15.11	7.78	15.08	7.85	15.04	7.92	17
18	16.04	8.17	16.00	8.24	15.97	8.31	15.93	8.38	18
19	16.93	8.63	16.89	8.70	16.85	8.77	16.81	8.85	19
20	17.82	9.08	17.78	9.16	17.74	9.23	17.70	9.31	20
21	18.71	9.53	18.67	9.62	18.63	9.70	18.58	9.78	21
22	19.60	9.99	19.56	10.07	19.51	10.16	19.47	10.24	22
23	20.49	10.44	20.45	10.53	20.40	10.62	20.35	10.71	23
24	21.38	10.90	21.34	10.99	21.29	11.08	21.24	11.17	24
25	22.28	11.35	22.23	11.45	22.18	11.54	22.12	11.64	25
26	23.17	11.80	23.11	11.90	23.06	12.01	23.01	12.11	26
27	24.06	12.26	24.00	12.36	23.95	12.47	23.89	12.57	27
28	24.95	12.71	24.89	12.82	24.84	12.93	24.78	13.04	28
29	25.64	13.17	25.78	13.28	25.72	13.39	25.66	13.50	29
30	26.73	13.62	26.67	13.74	26.61	13.85	26.55	13.97	30
31	27.62	14.07	27.56	14.19	27.50	14.31	27.43	14.43	31
32	28.51	14.53	28.45	14.65	28.38	14.78	28.32	14.90	32
33	29.40	14.98	29.34	15.11	29.27	15.24	29.20	15.37	33
34	30.29	15.44	30.23	15.57	30.16	15.70	30.09	15.83	34
35	31.19	15.89	31.12	16.03	31.05	16.16	30.97	16.30	35
36	32.08	16.34	32.00	16.48	31.93	16.62	31.86	16.76	36
37	32.97	16.80	32.89	16.94	32.82	17.08	32.74	17.23	37
38	33.86	17.25	33.78	17.40	33.71	17.55	33.63	17.69	38
39	34.75	17.71	34.67	17.86	34.59	18.01	34.51	18.16	39
40	35.64	18.16	35.56	18.31	35.48	18.47	35.40	18.62	40
41	36.53	18.61	36.45	18.77	36.37	18.93	36.28	19.09	41
42	37.42	19.07	37.34	19.23	37.25	19.39	37.17	19.56	42
43	38.31	19.52	38.23	19.69	38.14	19.86	38.05	20.02	43
44	39.20	19.98	39.12	20.15	39.03	20.32	38.94	20.49	44
45	40.10	20.43	40.01	20.60	39.92	20.78	39.82	20.95	45
46	40.99	20.88	40.89	21.06	40.80	21.24	40.71	21.42	46
47	41.88	21.34	41.78	21.52	41.69	21.70	41.59	21.88	47
48	42.77	21.79	42.67	21.98	42.58	22.16	42.48	22.35	48
49	43.66	22.25	43.56	22.44	43.46	22.63	43.36	22.82	49
50	44.55	22.70	44.45	22.89	44.35	23.09	44.25	23.28	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	63 Deg.		62¾ Deg.		62½ Deg.		62¼ Deg.		Dist.

Dist.	27 Deg.		27¼ Deg.		27½ Deg.		27¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	45.44	23,15	45,34	23,35	45,24	23,55	45,13	23,75	51
52	46.33	23,61	46,23	23,81	46,12	24,01	46,02	24,21	52
53	47.22	24,06	47,12	24,27	47,01	24,47	46,90	24,68	53
54	48,11	24,52	48,01	24,73	47,90	24,93	47,79	25,14	54
55	49,01	24,97	48,90	25,18	48,79	25,40	48,67	25,61	55
56	49,90	25,42	49,78	25,64	49,67	25,86	49,56	26,07	56
57	50,79	25,88	50,67	26,10	50,56	26,32	50,44	26,54	57
58	51,68	26,33	51,56	26,56	51,45	26,78	51,33	27,01	58
59	52,57	26,79	52,45	27,01	52,33	27,24	52,21	27,47	59
60	53,46	27,24	53,34	27,47	53,22	27,70	53,10	27,94	60
61	54,35	27,69	54,23	27,93	54,11	28,17	53,98	28,40	61
62	55,24	28,15	55,12	28,39	54,99	28,63	54,87	28,87	62
63	56,13	28,60	56,01	28,85	55,88	29,09	55,75	29,33	63
64	57,02	29,06	56,90	29,30	56,77	29,55	56,64	29,80	64
65	57,92	29,51	57,79	29,76	57,66	30,01	57,52	30,26	65
66	58,81	29,96	58,68	30,22	58,54	30,48	58,41	30,73	66
67	59,70	30,42	59,56	30,68	59,43	30,94	59,29	31,20	67
68	60,59	30,87	60,45	31,14	60,32	31,40	60,18	31,66	68
69	61,48	31,33	61,34	31,59	61,20	31,86	61,06	32,13	69
70	62,37	31,78	62,23	32,05	62,09	32,32	61,95	32,59	70
71	63,26	32,23	63,12	32,51	62,98	32,78	62,83	33,06	71
72	64,15	32,69	64,01	32,97	63,86	33,25	63,72	33,52	72
73	65,04	33,14	64,90	33,42	64,75	33,71	64,60	33,99	73
74	65,93	33,60	65,79	33,88	65,64	34,17	65,49	34,46	74
75	66,83	34,05	66,68	34,34	66,53	34,63	66,37	34,92	75
76	67,72	34,50	67,57	34,80	67,41	35,09	67,26	35,39	76
77	68,61	34,96	68,45	35,26	68,30	35,55	68,14	35,85	77
78	69,50	35,41	69,34	35,71	69,19	36,02	69,03	36,32	78
79	70,39	35,87	70,23	36,17	70,07	36,48	69,91	36,78	79
80	71,28	36,32	71,12	36,63	70,96	36,94	70,80	37,25	80
81	72,17	36,77	72,01	37,09	71,85	37,40	71,68	37,71	81
82	73,06	37,23	72,90	37,55	72,73	37,86	72,57	38,18	82
83	73,95	37,68	73,79	38,00	73,62	38,33	73,45	38,65	83
84	74,84	38,14	74,68	38,46	74,51	38,79	74,34	39,11	84
85	75,74	38,59	75,57	38,92	75,40	39,2	75,22	39,58	85
86	76,63	39,04	76,46	39,38	76,28	39,71	76,11	40,04	86
87	77,52	39,50	77,34	39,83	77,17	40,17	76,99	40,51	87
88	78,41	39,95	78,23	40,29	78,06	40,63	77,88	40,97	88
89	79,30	40,41	79,12	40,75	78,94	41,10	78,76	41,44	89
90	80,19	40,86	80,01	41,21	79,83	41,56	79,65	41,91	90
91	81,08	41,31	80,90	41,67	80,72	42,02	80,53	42,37	91
92	81,97	41,77	81,79	42,12	81,60	42,48	1,42	42,84	92
93	82,86	42,22	82,68	42,58	82,49	42,94	82,30	43,30	93
94	83,75	42.68	83,57	43,04	83,38	43,40	3,19	43,77	94
95	84,65	43,13	84,46	43,50	84,27	43,87	84,07	44,23	95
96	85,54	43,58	85,35	43,96	85,15	44,33	84,90	44,70	96
97	86,43	44,04	86,23	44,41	86,04	44,79	5,84	45,16	97
98	87,32	44,49	87,12	44,87	86,93	45,2	86,73	45,63	98
99	88.21	44,95	88,01	45,33	87,81	45,71	87,0	46,10	99
100	89,10	45,40	89,90	45,79	88,70	46,17	88,50	46,56	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	63 Deg.		62¾ Deg.		62½ Deg.		62¼ Deg.		

Dist.	28 Deg.		28¼ Deg.		28½ Deg.		28¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.88	0.47	0.88	0.47	0.88	0.48	0.88	0.48	1
2	1.77	0.94	1.76	0.95	1.76	0.95	1.75	0.96	2
3	2.65	1.41	2.64	1.42	2.64	1.43	2.63	1.44	3
4	3.53	1.88	3.52	1.89	3.52	1.91	3.51	1.92	4
5	4.41	2.35	4.40	2.37	4.39	2.39	4.38	2.40	5
6	5.30	2.82	5.29	2.84	5.27	2.86	5.26	2.89	6
7	6.18	3.29	6.17	3.31	6.15	3.34	6.14	3.37	7
8	7.06	3.76	7.05	3.79	7.03	3.82	7.01	3.85	8
9	7.95	4.23	7.93	4.26	7.91	4.29	7.89	4.33	9
10	8.83	4.69	8.81	4.73	8.79	4.77	8.77	4.81	10
11	9.71	5.16	9.69	5.21	9.67	5.25	9.64	5.29	11
12	10.60	5.63	10.57	5.68	10.55	5.73	10.52	5.77	12
13	11.48	6.10	11.45	6.15	11.42	6.20	11.40	6.25	13
14	12.36	6.57	12.33	6:63	12.30	6.68	12.27	6.73	14
15	13.24	7.04	13.21	7.10	13.18	7.16	13.15	7.21	15
16	14.13	7.51	14.09	7.57	14.06	7.63	14.03	7.70	16
17	15.01	7.98	14.98	8.05	14.94	8.11	14.90	8.18	17
18	15.89	8.45	15.86	8.52	15.82	8.59	15.78	8.66	18
19	16.78	8.92	16.74	8.99	16.70	9.07	16.66	9.14	19
20	17.66	9.39	17.62	9.47	17.58	9.54	17.53	9.62	20
21	18.54	9.86	18.50	9.94	18.46	10.02	18.41	10.10	21
22	19.42	10.33	19.38	10.41	19.33	10.50	19.29	10.58	22
23	20.31	10.80	20.26	10.89	20.21	10.97	20.16	11.06	23
24	21.19	11.27	21.14	11.36	21.09	11.45	21.04	11.54	24
25	22.07	11.74	22.02	11.83	21.97	11.93	21.92	12.02	25
26	22.96	12.21	22.90	12.31	22.85	12.41	22.79	12.51	26
27	23.84	12.68	23.78	12.78	23.73	12.88	23.67	12.99	27
28	24.72	13.15	24.66	13.25	24.61	13.36	24.55	13.47	28
29	25.61	13.61	25.55	13.73	25.49	13.84	25.43	13.95	29
30	26.49	14.08	26.43	14.20	26.36	14.31	26.30	14.43	30
31	27.37	14.55	27.31	14.67	27.24	14.79	27.18	14.91	31
32	28.25	15.02	28.19	15.15	28.12	15.27	28.06	15.39	32
33	29.14	15.49	29.07	15.62	29.00	15.75	28.93	15.87	33
34	30.02	15.96	29.95	16.09	29.88	16.22	29.81	16.35	34
35	30.90	16.43	30.83	16.57	30.76	16.70	30.69	16.83	35
36	31.79	16.90	31.71	17.04	31.64	17.18	31.56	17.32	36
37	32.67	17.37	32.59	17.51	32.52	17.65	32.44	17.80	37
38	33.55	17.84	33.47	17.99	33.39	18.13	33.32	18.28	38
39	34.43	18.31	34.35	18.46	34.27	18.61	34.19	18.76	39
40	35.32	18.78	35.24	18.93	35.15	19.09	35.07	19.24	40
41	36.20	19.25	36.12	19.41	36.03	19.56	35.95	19.72	41
42	37.08	19.72	37.00	19.88	36.91	20.04	36.82	20.20	42
43	37.97	20.19	37.88	20.35	37.79	20.52	37.70	20.68	43
44	38.85	20.66	38.76	20.83	38.67	20.99	38.58	21.16	44
45	39.73	21.13	39.64	21.30	39.55	21.47	39.45	21.64	45
46	40.62	21.60	40.52	21.77	40.43	21.95	40.33	22.13	46
47	41.50	22.07	41.40	22.25	41.30	22.43	41.21	22.61	47
48	42.38	22.53	42.28	22.72	42.18	22.90	42.08	23.09	48
49	43.26	23.00	43.16	23.19	43.06	23.38	42.96	23.57	49
50	44.15	23.47	44.	23.67	43. 4	23.86	43.84	24.05	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	62 Deg.		61¾ Deg.		61½ Deg.		61¼ Deg.		

Dist.	28 Deg.		28¼ Deg.		28½ Deg.		28¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	45.03	23.94	44.93	24.14	44.82	24.34	44.71	24.53	51
52	45.91	24.41	45.81	24.61	45.70	24.81	45.59	25.01	52
53	46.80	24.88	46.69	25.09	46.58	25.29	46.47	25.49	53
54	47.68	25.35	47.57	25.56	47.46	25.77	47.34	25.97	54
55	48.56	25.82	48.45	26.03	48.33	26.24	48.22	26.45	55
56	49.45	26.29	49.33	26.51	49.21	26.72	49.10	26.94	56
57	50.33	26.76	50.21	26.98	50.09	27.20	49.97	27.42	57
58	51.21	27.23	51.09	27.45	50.97	27.68	50.85	27.90	58
59	52.09	27.70	51.97	27.93	51.85	28.15	51.73	28.38	59
60	52.98	28.17	52.85	28.40	52.73	28.63	52.60	28.86	60
61	53.86	28.64	53.73	28.87	53.61	29.11	53.48	29.34	61
62	54.74	29.11	54.62	29.35	54.49	29.58	54.36	29.82	62
63	55.63	29.58	55.50	29.82	55.37	30.06	55.23	30.30	63
64	56.51	30.05	56.38	30.29	56.24	30.54	56.11	30.78	64
65	57.39	30.52	57.26	30.77	57.12	31.02	56.99	31.26	65
66	58.27	30.99	58.14	31.24	58.00	31.49	57.86	31.75	66
67	59.16	31.45	59.02	31.71	58.88	31.97	58.74	32.23	67
68	60.04	31.92	59.90	32.19	59.76	32.45	59.62	32.71	68
69	60.92	32.39	60.78	32.66	60.64	32.92	60.49	33.19	69
70	61.81	32.86	61.66	33.13	61.52	33.40	61.37	33.67	70
71	62.69	33.33	62.54	33.61	62.40	33.88	62.25	34.15	71
72	63.57	33.80	63.42	34.08	63.27	34.36	63.12	34.63	72
73	64.46	34.27	64.30	34.55	64.15	34.83	64.00	35.11	73
74	65.34	34.74	65.19	35.03	65.03	35.31	64.88	35.59	74
75	66.22	35.21	66.07	35.50	65.91	35.79	65.75	36.07	75
76	67.10	35.68	66.95	35.97	66.79	36.26	66.63	36.56	76
77	67.99	36.15	67.83	36.45	67.67	36.74	67.51	37.04	77
78	68.87	36.62	68.71	36.92	68.55	37.22	68.38	37.52	78
79	69.75	37.09	69.59	37.39	69.43	37.70	69.26	38.00	79
80	70.64	37.56	70.47	37.87	70.31	38.17	70.14	38.48	80
81	71.52	38.03	71.35	38.34	71.18	38.65	71.01	38.96	81
82	72.40	38.50	72.23	38.81	72.06	39.13	71.89	39.44	82
83	73.28	38.97	73.11	39.29	72.94	39.60	72.77	39.92	83
84	74.17	39.44	73.99	39.76	73.82	40.08	73.64	40.40	84
85	75.05	39.91	74.88	40.23	74.70	40.56	74.52	40.88	85
86	75.93	40.37	75.76	40.71	75.58	41.04	75.40	41.36	86
87	76.82	40.84	76.64	41.18	76.46	41.51	76.28	41.85	87
88	77.70	41.31	77.52	41.65	77.34	41.99	77.15	42.33	88
89	78.58	41.78	78.40	42.13	78.21	42.47	78.03	42.81	89
90	79.47	42.25	79.28	42.60	79.09	42.94	78.91	43.29	90
91	80.35	42.72	80.16	43.07	79.97	43.42	79.78	43.77	91
92	81.23	43.19	81.04	43.55	80.85	43.90	80.66	44.25	92
93	82.11	43.66	81.92	44.02	81.73	44.38	81.54	44.73	93
94	83.00	44.13	82.80	44.49	82.61	44.85	82.41	45.21	94
95	83.88	44.60	83.68	44.97	83.49	45.33	83.29	45.69	95
96	84.76	45.07	84.57	45.44	84.37	45.81	84.17	46.17	96
97	85.65	45.54	85.45	45.91	85.25	46.28	85.04	46.66	97
98	86.53	46.01	86.33	46.39	86.12	46.76	85.92	47.14	98
99	87.41	46.48	87.21	46.86	87.00	47.24	86.80	47.62	99
100	88.29	46.95	88.09	47.33	87.88	47.72	87.67	48.10	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	62 Deg.		61¾ Deg.		61½ Deg.		61¼ Deg.		

TRAVERSE TABLE.

Dist.	29 Deg.		29¼ Deg.		29½ Deg.		29¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.87	0.48	0.87	0.49	0.87	0.49	0.87	0.50	1
2	1.75	0.97	1.74	0.98	1.74	0.98	1.74	0.99	2
3	2.62	1.45	2.62	1.47	2.61	1.48	2.60	1.49	3
4	3.50	1.94	3.49	1.95	3.48	1.97	3.47	1.98	4
5	4.37	2.42	4.36	2.44	4.35	2.46	4.34	2.48	5
6	5.25	2.91	5.23	2.93	5.22	2.95	5.21	2.98	6
7	6.12	3.39	6.11	3.42	6.09	3.45	6.08	3.47	7
8	7.00	3.88	6.09	3.01	6.06	3.04	6.95	3.97	8
9	7.87	4.36	7.85	4.40	7.83	4.43	7.81	4.47	9
10	8.75	4.85	8.72	4.89	8.70	4.92	8.68	4.96	10
11	9.62	5.33	9.60	5.37	9.57	5.42	9.55	5.46	11
12	10.50	5.82	10.47	5.86	10.44	5.01	10.42	5.95	12
13	11.37	6.30	11.34	6.35	11.31	6.40	11.29	6.45	13
14	12.24	6.79	12.21	6.84	12.18	6.89	12.15	6.95	14
15	13.12	7.27	13.09	7.33	13.06	7.39	13.02	7.44	15
16	13.99	7.76	13.96	7.82	13.93	7.88	13.89	7.94	16
17	14.87	8.24	14.83	8.31	14.80	8.37	14.76	8.44	17
18	15.74	8.73	15.70	8.80	15.67	8.86	15.63	8.93	18
19	16.62	9.21	16.58	9.28	16.54	9.36	16.50	9.43	19
20	17.49	9.70	17.45	9.77	17.41	9.85	17.36	9.92	20
21	18.37	10.18	18.32	10.26	18.28	10.34	18.23	10.42	21
22	19.24	10.67	19.19	10.75	19.15	10.83	19.10	10.92	22
23	20.12	11.15	20.07	11.24	20.02	11.33	19.97	11.41	23
24	20.99	11.64	20.94	11.73	20.89	11.82	20.84	11.91	24
25	21.87	12.12	21.81	12.22	21.76	12.31	21.70	12.41	25
26	22.74	12.60	22.68	12.70	22.63	12.80	22.57	12.90	26
27	23.61	13.09	23.56	13.19	23.50	13.30	23.44	13.40	27
28	24.49	13.57	24.43	13.68	24.37	13.79	24.31	13.89	28
29	25.36	14.06	25.30	14.17	25.24	14.28	25.18	14.39	29
30	26.24	14.54	26.17	14.66	26.11	14.77	26.05	14.89	30
31	27.11	15.03	27.05	15.15	26.98	15.27	26.91	15.38	31
32	27.99	15.51	27.92	15.64	27.85	15.76	27.78	15.88	32
33	28.86	16.00	28.79	16.12	28.72	16.25	28.65	16.38	33
34	29.74	16.48	29.66	16.61	29.59	16.74	29.52	16.87	34
35	30.61	16.97	30.54	17.10	30.46	17.23	30.39	17.37	35
36	31.49	17.45	31.41	17.59	31.33	17.73	31.26	17.86	36
37	32.36	17.94	32.28	18.08	32.20	18.22	32.12	18.36	37
38	33.24	18.42	33.15	18.57	33.07	18.71	32.99	18.86	38
39	34.11	18.91	34.03	19.06	33.94	19.20	33.86	19.35	39
40	34.98	19.39	34.90	19.54	34.81	19.70	34.73	19.85	40
41	35.86	19.88	35.77	20.03	35.68	20.19	35.60	20.34	41
42	36.73	20.36	36.64	20.52	36.55	20.68	36.46	20.84	42
43	37.61	20.85	37.52	21.01	37.43	21.17	37.33	21.34	43
44	38.48	21.33	38.39	21.50	38.30	21.67	38.20	21.83	44
45	39.36	21.82	39.26	21.99	39.17	22.16	39.07	22.33	45
46	40.23	22.30	40.13	22.48	40.04	22.65	39.94	22.83	46
47	41.11	22.79	41.01	22.97	40.91	23.14	40.81	23.32	47
48	41.98	23.27	41.88	23.45	41.78	23.63	41.67	23.82	48
49	42.86	23.76	42.75	23.94	42.65	24.13	42.54	24.31	49
50	43.73	24.24	43.62	24.43	43.52	24.62	43.41	24.81	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	61 Deg.		60¾ Deg.		60½ Deg.		60¼ Deg.		Dist.

Dist.	29 Deg.		29¼ Deg.		29½ Deg.		29¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	44.61	24.73	44.50	24.92	44.39	25.11	44.28	25.31	51
52	45.48	25.21	45.37	25.41	45.26	25.61	45.15	25.80	52
53	46,35	25.69	46.24	25.90	46.13	26.10	46.01	26.30	53
54	47.23	26.18	47.11	26.39	47.00	26.59	46.88	26.80	54
55	48.10	26.66	47.99	26.87	47.87	27.08	47.75	27.29	55
56	48.98	27.15	48.86	27.36	48.74	27.58	48.62	27.79	56
57	49.85	27.63	49.73	27.85	49.61	28.07	49.49	28.28	57
58	50.73	28.12	50.60	28.34	50.48	28.56	50.36	28.78	58
59	51.60	28.60	51.48	28.83	51.35	29.05	51.22	29.28	59
60	52.48	29.09	52.35	29.32	52.22	29.55	52.09	29.77	60
61	53.35	29.57	53.22	29.81	53.09	30.04	52.96	30.27	61
62	54.23	30.06	54.09	30.29	53.96	30.53	53.83	30.77	62
63	55.10	30.54	54.97	30.78	54.83	31.02	54.70	31.26	63
64	55.98	31.03	55.84	31.27	55.70	31.52	55.56	31.76	64
65	56.85	31.51	56.71	31.76	56.57	32.01	56.43	32.25	65
66	57.72	32.00	57.58	32.25	57.44	32.50	57.30	32.75	66
67	58.60	32.48	58.46	32.74	58.31	32.99	58.17	33.25	67
68	59.47	32.97	59.33	33.23	59.18	33.48	59.04	33.74	68
69	60.35	33.45	60.20	33.71	60.05	33.98	59.91	34.24	69
70	61.22	33.94	61.07	34.20	60.92	34.47	60.77	34.74	70
71	62,10	34.42	61.95	34.69	61.80	34.96	61.64	35.23	71
72	62.97	34.91	62.82	35.18	62.67	35.45	62.51	35.73	72
73	63,85	35.39	63.69	35.67	63.54	35.95	63.38	36.22	73
74	64.72	35.88	64.56	36.16	64.41	36.44	64.25	36.72	74
75	65.60	36.36	65.44	36.65	65.28	36.93	65.11	37.22	75
76	66.47	36.85	66.31	37.14	66.15	37.42	65.98	37.71	76
77	67.35	37.33	67.18	37.62	67.02	37.92	66.85	38.21	77
78	68.22	37.82	68.05	38.11	67.89	38.41	67.72	38.70	78
79	69.09	38.30	68.93	38.60	68.76	38.90	68.59	39.20	79
80	69.97	38.78	69.80	39.09	69.63	39.39	69.46	39.70	80
81	70.84	39.27	70.67	39.58	70.50	39.89	70.32	40.19	81
82	71.72	39.75	71.54	40.07	71.37	40.38	71.19	40.69	82
83	72.59	40.24	72.42	40.56	72.24	40.87	72.06	41.19	83
84	73.47	40.72	73.29	41.04	73.11	41.36	72.93	41.68	84
85	74.34	41.21	74.16	41.53	73.98	41.86	73.80	42.18	85
86	75.22	41.69	75.03	42.02	74.85	42.35	74.67	42.67	86
87	76.09	42.18	75.91	42.51	75.72	42.84	75.53	43.17	87
88	76.97	42.66	76.78	43.00	76.59	43.33	76.40	43.67	88
89	77.84	43.15	77.65	43.49	77.46	43.83	77.27	44.16	89
90	78.72	43.63	78.52	43.98	78.33	44.32	78.14	44.66	90
91	79.59	44.12	79.40	44.46	79.20	44.81	79.01	45.16	91
92	89.46	44.60	80.27	44.95	80.07	45.30	79.87	45.65	92
93	81.34	45.09	81.14	45.44	80.94	45.80	80.74	46.15	93
94	82.21	45.57	82.01	45.93	81.81	46.29	81.61	46.64	94
95	83.09	46.06	82.89	46.42	82.68	46.78	82.48	47.14	95
96	83.96	46.54	83.76	46.91	83.55	47.27	83.35	47.64	96
97	84.84	47.03	84.63	47.40	84.42	47.77	84.22	48.13	97
98	85.71	47.51	85.50	47.88	85.29	48.26	85.08	48.63	98
99	86.59	48.00	86.38	48.37	86.17	48.75	85.95	49.17	99
100	87.46	48.48	87.25	48.86	87.04	49.24	86.82	49.62	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	61 Deg.		60¾ Deg.		60½ Deg.		60¼ Deg.		Dist.

Diſt.	30 Deg.		30¼ Deg.		30½ Deg.		30¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,87	0,50	0,86	0,50	0,86	0,51	0,86	0,51	1
2	1,73	1,00	1,73	1,01	1,72	1,02	1,72	1,02	2
3	2,60	1,50	2,59	1,51	2,58	1,52	2,58	1,53	3
4	3,46	2,00	3,46	2,02	3,45	2,03	3,44	2,05	4
5	4,33	2,50	4,32	2,52	4,31	2,54	4,30	2,56	5
6	5,20	3,00	5,18	3,02	5,17	3,05	5,16	3,07	6
7	6,06	3,50	6,05	3,53	6,03	3,55	6,02	3,58	7
8	6,93	4,00	6,91	4,03	6,89	4,06	6,88	4,09	8
9	7,79	4,50	7,77	4,53	7,75	4,57	7,73	4,60	9
10	8,66	5,00	8,64	5,04	8,62	5,08	8,59	5,11	10
11	9,53	5,50	9,50	5,54	9,48	5,58	9,45	5,62	11
12	10,39	6,00	10,37	6,05	10,34	6,09	10,31	6,14	12
13	11,26	6,50	11,23	6,55	11,20	6,60	11,17	6,65	13
14	12,12	7,00	12,09	7,05	12,06	7,11	12,03	7,16	14
15	12,99	7,50	12,96	7,56	12,92	7,61	12,89	7,67	15
16	13,86	8,00	13,82	8,06	13,79	8,12	13,75	8,18	16
17	14,72	8,50	14,69	8,56	14,65	8,63	14,61	8,69	17
18	15,59	9,00	15,55	9,07	15,51	9,14	15,47	9,20	18
19	16,45	9,50	16,41	9,57	16,37	9,64	16,33	9,71	19
20	17,32	10,00	17,28	10,08	17,23	10,15	17,19	10,23	20
21	18,19	10,50	18,14	10,58	18,09	10,66	18,05	10,74	21
22	19,05	11,00	19,00	11,08	18,96	11,17	18,91	11,25	22
23	19,92	11,50	19,87	11,59	19,82	11,67	19,77	11,76	23
24	20,78	12,00	20,73	12,09	20,68	12,18	20,63	12,27	24
25	21,65	12,50	21,60	12,59	21,54	12,69	21,49	12,78	25
26	22,52	13,00	22,46	13,10	22,40	13,20	22,34	13,29	26
27	23,38	13,50	23,32	13,60	23,26	13,70	23,20	13,80	27
28	24,25	14,00	24,19	14,11	24,13	14,21	24,06	14,32	28
29	25,11	14,50	25,05	14,61	24,99	14,72	24,92	14,83	29
30	25,98	15,00	25,92	15,11	25,85	15,23	25,78	15,34	30
31	26,85	15,50	26,78	15,62	26,71	15,73	26,64	15,85	31
32	27,71	16,00	27,64	16,12	27,57	16,24	27,50	16,36	32
33	28,58	16,50	28,51	16,62	28,43	16,75	28,36	16,87	33
34	29,44	17,00	29,37	17,13	29,30	17,26	29,22	17,38	34
35	30,31	17,50	30,23	17,63	30,16	17,76	30,08	17,90	35
36	31,18	18,00	31,10	18,14	31,02	18,27	30,94	18,41	36
37	32,04	18,50	31,96	18,64	31,88	18,78	31,80	18,92	37
38	32,91	19,00	32,83	19,14	32,74	19,29	32,66	19.43	38
39	33,77	19,50	33,69	19,65	33,60	19,79	33,52	19,94	39
40	34,64	20,00	34,53	20,15	34,47	20,30	34,38	20,45	40
41	35,51	20,50	35,42	20,65	35,33	20,81	35,24	20,96	41
42	36,37	21,00	36,28	21,16	36,19	21,32	36,10	21,47	42
43	37,24	21,50	37,14	21,66	37,05	21,82	36,95	21,99	43
44	38,11	22,00	38,01	22,17	37,91	22,33	37,81	22,50	44
45	38,97	22,50	38,87	22,67	38,77	22,84	38,67	23,01	45
46	39,84	23,00	39,74	23,17	39,63	23,35	39,53	23,52	46
47	40,70	23,50	40,60	23,68	40,50	23,85	40,39	24,03	47
48	41,57	24,00	41,46	24,18	41,36	24,36	41,25	24,54	48
49	42,44	24,50	42,33	24,68	42,22	24,87	42,11	25,05	49
50	43,30	25,00	43,19	25,19	43,08	25,38	42,97	25,56	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	60 Deg.		59¾ Deg.		59½ Deg.		59¼ Deg.		

Dist.	30 Deg.		30¼ Deg.		30½ Deg.		30¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	44.17	25.50	44.06	25.69	43.94	25.88	43.83	26.08	51
52	45.03	26.00	44.92	26.20	44.80	26.39	44.69	26.59	52
53	45.90	26.50	45.78	26.70	45.67	26.90	45.55	27.10	53
54	46.77	27.00	46.65	27.20	46.53	27.41	46.41	27.61	54
55	47.63	27.50	47.51	27.71	47.39	27.91	47.27	28.12	55
56	48.50	28.00	48.37	28.21	48.25	28.42	48.13	28.63	56
57	49.36	28.50	49.24	28.72	49.11	28.93	48.99	29.14	57
58	50.23	29.00	50.10	29.22	49.97	29.44	49.85	29.65	58
59	51.10	29.50	50.97	29.72	50.84	29.94	50.70	30.17	59
60	51.96	30.00	51.83	30.23	51.70	30.45	51.56	30.68	60
61	52.83	30.50	52.69	30.73	52.56	30.96	52.42	31.19	61
62	53.69	31.00	53.56	31.23	53.42	31.47	53.28	31.70	62
63	54.56	31.50	54.42	31.74	54.28	31.97	54.14	32.21	63
64	55.43	32.00	55.29	32.24	55.14	32.48	55.00	32.72	64
65	56.29	32.50	56.15	32.75	56.01	32.99	55.86	33.23	65
66	57.16	33.00	57.01	33.25	56.87	33.50	56.72	33.75	66
67	58.02	33.50	57.88	33.75	57.73	34.01	57.58	34.26	67
68	58.89	34.00	58.74	34.26	58.59	34.51	58.44	34.77	68
69	59.76	34.50	59.60	34.76	59.45	35.02	59.30	35.28	69
70	60.62	35.00	60.47	35.26	60.31	35.53	60.16	35.79	70
71	61.49	35.50	61.33	35.77	61.18	36.04	61.02	36.30	71
72	62.35	36.00	62.20	36.27	62.04	36.54	61.88	36.81	72
73	63.22	36.50	63.06	36.78	62.90	37.05	62.74	37.32	73
74	64.09	37.00	63.92	37.28	63.76	37.56	63.60	37.84	74
75	64.95	37.50	64.79	37.78	64.62	38.07	64.46	38.35	75
76	65.82	38.00	65.65	38.29	65.48	38.57	65.31	38.86	76
77	66.68	38.50	66.52	38.79	66.35	39.08	66.17	39.37	77
78	67.55	39.00	67.38	39.29	67.21	39.59	67.03	39.88	78
79	68.42	39.50	68.24	39.80	68.07	40.10	67.89	40.39	79
80	69.28	40.00	69.11	40.30	68.93	40.60	68.75	40.90	80
81	70.15	40.50	69.97	40.81	69.79	41.11	69.61	41.41	81
82	71.01	41.00	70.83	41.31	70.65	41.62	70.47	41.93	82
83	71.88	41.50	71.70	41.81	71.52	42.13	71.33	42.44	83
84	72.75	42.00	72.56	42.32	72.38	42.63	72.19	42.95	84
85	73.61	42.50	73.43	42.82	73.24	43.14	73.05	43.46	85
86	74.48	43.00	74.29	43.32	74.10	43.65	73.91	43.97	86
87	75.34	43.50	75.15	43.83	74.96	44.16	74.77	44.48	87
88	76.21	44.00	76.02	44.33	75.82	44.66	75.63	44.99	88
89	77.08	44.50	76.88	44.84	76.68	45.17	76.49	45.51	89
90	77.94	45.00	77.75	45.34	77.55	45.68	77.35	46.02	90
91	78.81	45.50	78.61	45.84	78.41	46.19	78.21	46.53	91
92	79.67	46.00	79.47	46.35	79.27	46.69	79.07	47.04	92
93	80.54	46.50	80.34	46.85	80.13	47.20	79.92	47.55	93
94	81.41	47.00	81.20	47.35	80.99	47.71	80.78	48.06	94
95	82.27	47.50	82.06	47.86	81.85	48.22	81.64	48.57	95
96	83.14	48.00	82.93	48.36	82.72	48.72	82.50	49.08	96
97	84.00	48.50	83.79	48.87	83.58	49.23	83.36	49.60	97
98	84.87	49.00	84.66	49.37	84.44	49.74	84.22	50.11	98
99	85.74	49.50	85.52	49.87	85.30	50.25	85.08	50.62	99
100	86.60	50.00	86.38	50.38	86.16	50.75	85.94	51.13	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	60 Deg.		59¾ Deg.		59½ Deg.		59¼ Deg.		Dist.

Diſt.	31 Deg.		31¼ Deg.		31½ Deg.		31¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.86	0.51	0.85	0.52	0.85	0.52	0.85	0.53	1
2	1.71	1.03	1.71	1.04	1.71	1.04	1.70	1.05	2
3	2.57	1.55	2.56	1.56	2.56	1.57	2.55	1.58	3
4	3.43	2.06	3.42	2.08	3.41	2.09	3.40	2.10	4
5	4.29	2.58	4.27	2.59	4.26	2.61	4.25	2.63	5
6	5.14	3.09	5.13	3.11	5.12	3.13	5.10	3.16	6
7	6.00	3.61	5.98	3.63	5.97	3.66	5.95	3.68	7
8	6.86	4.12	6.84	4.15	6.82	4.18	6.80	4.21	8
9	7.71	4.64	7.69	4.67	7.67	4.70	7.65	4.74	9
10	8.57	5.15	8.55	5.19	8.53	5.22	8.50	5.26	10
11	9.43	5.67	9.40	5.71	9.38	5.75	9.35	5.79	11
12	10.29	6.18	10.26	6.23	10.23	6.27	10.20	6.31	12
13	11.14	6.70	11.11	6.74	11.08	6.79	11.05	6.84	13
14	12.00	7.21	11.97	7.26	11.94	7.31	11.90	7.37	14
15	12.86	7.73	12.82	7.78	12.79	7.84	12.76	7.89	15
16	13.71	8.24	13.68	8.30	13.64	8.36	13.61	8.42	16
17	14.57	8.76	14.53	8.82	14.49	8.88	14.46	8.95	17
18	15.43	9.27	15.39	9.34	15.35	9.40	15.31	9.47	18
19	16.29	9.79	16.24	9.86	16.20	9.93	16.16	10.00	19
20	17.14	10.30	17.10	10.38	17.05	10.45	17.01	10.52	20
21	18.00	10.82	17.95	10.89	17.91	10.97	17.86	11.05	21
22	18.86	11.33	18.81	11.41	18.76	11.49	18 71	11.58	22
23	19.71	11.85	19.66	11.93	19.61	12.02	19.56	12.10	23
24	20.57	12.36	20.52	12.45	20.46	12.54	20.41	12.63	24
25	21.43	12.88	21.37	12.97	21.32	13.06	21.26	13.16	25
26	22.29	13.39	22.23	13.49	22.17	13.58	22.11	13.68	26
27	23.14	13.91	23.08	14.01	23.02	14.11	22.96	14.21	27
28	24.00	14.42	23.94	14.53	23.87	14.63	23.81	14.73	28
29	24.86	14.94	24.79	15.04	24.73	15.15	24.66	15.26	29
30	25.71	15.45	25.65	15.56	25.58	15.67	25.51	15.79	30
31	26.57	15.97	26.50	16.08	26.43	16.20	26.36	16.31	31
32	27.43	16.48	27.36	16.60	27.28	16.72	27.21	16.84	32
33	28.29	17.00	28.21	17.12	28.14	17.24	28.06	17.37	33
34	29.14	17.51	29.07	17.64	28.99	17.76	28.91	17.89	34
35	30.00	18.03	29.92	18.16	29.84	18.29	29.76	18.42	35
36	30.86	18.54	30.78	18.68	30.70	18.81	30.61	18.94	36
37	31.72	19.06	31.63	19.19	31.55	19.33	31.46	19.47	37
38	32.57	19.57	32.49	19.71	32.40	19.85	32.31	20.00	38
39	33.43	20.09	33.34	20.23	33.25	20.38	33.16	20.52	39
40	34.29	20.60	34.20	20.75	34.11	20.90	34.01	21.05	40
41	35.14	21.12	35.05	21.27	34.96	21.42	34.86	21.57	41
42	36.00	21.63	35.91	21.79	35.81	21.94	35.71	22.10	42
43	36.86	22.15	36.76	22.31	36.66	22.47	36.57	22.63	43
44	37.72	22.66	37.62	22.83	37.52	22.99	37.42	23.15	44
45	38.57	23.18	38.47	23.34	38.37	23.51	38.27	23.68	45
46	39.43	23.69	39.33	23.86	39.22	24.03	39.12	24.21	46
47	40.29	24.21	40.18	24.38	40.07	24.56	39.97	24.73	47
48	41.14	24.72	41.04	24.90	40.93	25.08	40.82	25.26	48
49	42.00	25.24	41.89	25.42	41.78	25.60	41.67	25.78	49
50	42.86	25.75	42.75	25.94	42.63	26.12	42.52	26.31	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	59 Deg.		58¾ Deg.		58½ Deg.		58¼ Deg.		

Diſt.	31 Deg.		31¼ Deg.		31½ Deg.		31¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	43.72	26.27	43.60	26.46	43.48	26.65	43.37	26.84	51
52	44.57	26.78	44.46	26.98	44.34	27.17	44.22	27.36	52
53	45.43	27.30	45.31	27.49	45.19	27.69	45.07	27.89	53
54	46,29	27.81	46.17	28.01	46.04	28.21	45.92	28.42	54
55	47,14	28.33	47.02	28.53	46.90	28.74	46.77	28.94	55
56	48,00	28.84	47.88	29.05	47.75	29.26	47.62	29.47	56
57	48.86	29.36	48.73	29.57	48.60	29.78	48.47	29.99	57
58	49.72	29.87	49.58	30.09	49.45	30.30	49.32	30.52	58
59	50.57	30.39	50.44	30.61	50.31	30.83	50.17	31.05	59
60	51.43	30.90	51.29	31.13	51.16	31.35	51.02	31.57	60
61	52.29	31.42	52.15	31.65	52.01	31.87	51.87	32.10	61
62	53.14	31.93	53.00	32.16	52.86	32.39	52.72	32.63	62
63	54.00	32.45	53.86	32.68	53.72	32.92	53.57	33.15	63
64	54.86	32.96	54.71	33.20	54.57	33.44	54.42	33.68	64
65	55.72	33.48	55.57	33.72	55.42	33.96	55.27	34.20	65
66	56.57	33.99	56.42	34.24	56.27	34.48	56.12	34.73	66
67	57,43	34.51	57.28	34.76	57.13	35.01	56.98	35.26	67
68	58.29	35,02	58.13	35.28	57.98	35.53	57.82	35.78	68
69	59.14	35.54	58.99	35.80	58.83	36.05	58.67	36.31	69
70	60.00	36.05	59.84	36.31	59.68	36.57	59.52	36.83	70
71	60.86	36.57	60.70	36.83	60.54	37.10	60.37	37.36	71
72	61.72	37.08	61.55	37.35	61.39	37.62	61.23	37.89	72
73	62.57	37.60	62.41	37.87	62.24	38.14	62.08	38.41	73
74	63,43	38.11	63.26	38.39	63.10	38.66	62.93	38.94	74
75	64.29	38.63	64.12	38.91	63.95	39.19	63.78	39.47	75
76	65.14	39.14	64.97	39.43	64.80	39.71	64.63	39.99	76
77	66.00	39.66	65.83	39.95	65.65	40.23	65.48	40.52	77
78	66.86	40.17	66.68	40.46	66.51	40.75	66.33	41.04	78
79	67.72	40.69	67.54	40.98	67.36	41.28	67.18	41.57	79
80	68.57	41.20	68.39	41.50	68.21	41.80	68.03	42.10	80
81	69.43	41.72	69.25	42.02	69.06	42.32	68.88	42.62	81
82	70.29	42.23	70.10	42.54	69.92	42.84	69.73	43.15	82
83	71.14	42.75	70.96	43.06	70.77	43.37	70.58	43.68	83
84	72,00	43.26	71.81	43.58	71.62	43.89	71.43	44.20	84
85	72.86	43.78	72.67	44.10	72.47	44.41	72.28	44.73	85
86	73.72	44.29	73.52	44.61	73.33	44.93	73.13	45.25	86
87	74.57	44.81	74.38	45.13	74.18	45.46	73.98	45.78	87
88	75.43	45.32	75.23	45.65	75.03	45.98	74.83	46.31	88
89	76.29	45.84	76.09	46.17	75.88	46.50	75.68	46.83	89
90	77.15	46.35	76.94	46.69	76.74	47.02	76.53	47.36	90
91	78.00	46.87	77.80	47.21	77.59	47.55	77.38	47.89	91
92	78.86	47.38	78.65	47.73	78.44	48.07	78.23	48.41	92
93	79.72	47.90	79.51	48.25	79.30	48.59	79.08	48.94	93
94	80.57	48.41	80.36	48.76	80.15	49.11	79.93	49.47	94
95	81.43	48.93	81.22	49.28	81.00	49.64	80.78	49.99	95
96	82.29	49.44	82.07	49.80	81.85	50.16	81.63	50.52	96
97	83.15	49.96	82.93	50.32	82.71	50.68	82.48	51.04	97
98	84.00	50.47	83.78	50.84	83.56	51.20	83.33	51.57	98
99	84.86	50.99	84.64	51.36	84.41	51.73	84.18	52.10	99
100	85.72	51.50	85.49	51.88	85.26	52.29	85.04	52.62	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Diſt.	59 Deg.		58¾ Deg.		58½ Deg.		58¼ Deg.		Diſt.

Dist.	32 Deg.		32¼ Deg.		32½ Deg		32¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.85	0.53	0.85	0.53	0.84	0.54	0.84	0.54	1
2	1.70	1.06	1.69	1.07	1.69	1.07	1.68	1.08	2
3	2.54	1.59	2.54	1.60	2.53	1.61	2.52	1.62	3
4	3.39	2.12	3.38	2.13	3.37	2.15	3.36	2.16	4
5	4.24	2.65	4.23	2.67	4.22	2.69	4.21	2.70	5
6	5.09	3.18	5.07	3.20	5.06	3.22	5.05	3.25	6
7	5.94	3.71	5.92	3.74	5.90	3.76	5.89	3.79	7
8	6.78	4.24	6.77	4.27	6.75	4.30	6.73	4.33	8
9	7.63	4.77	7.61	4.80	7.59	4.84	7.57	4.87	9
10	8.48	5.30	8.46	5.34	8.43	5.37	8.41	5.41	10
11	9.33	5.83	9.30	5.87	9.28	5.91	9.25	5.95	11
12	10.18	6.36	10.15	6.40	10.12	6.45	10.09	6.49	12
13	11.02	6.89	10.99	6.94	10.96	6.98	10.93	7.03	13
14	11.87	7.42	11.84	7.47	11.81	7.52	11.77	7.57	14
15	12.72	7.95	12.69	8.00	12.65	8.06	12.62	8.11	15
16	13.57	8.48	13.53	8.54	13.49	8.60	13.46	8.66	16
17	14.42	9.01	14.38	9.07	14.34	9.13	14.30	9.20	17
18	15.26	9.54	15.22	9.61	15.18	9.67	15.14	9.74	18
19	16.11	10.07	16.07	10.14	16.02	10.21	15.98	10.28	19
20	16.96	10.60	16.91	10.67	16.87	10.75	16.82	10.82	20
21	17.81	11.13	17.76	11.21	17.71	11.28	17.66	11.36	21
22	18.66	11.66	18.61	11.74	18.55	11.82	18 50	11.90	22
23	19.51	12.19	19.45	12.27	19.40	12.36	19.34	12.44	23
24	20.35	12.72	20.30	12.81	20.24	12.90	20.18	12.98	24
25	21.20	13.25	21.14	13.34	21.08	13.43	21.03	13.52	25
26	22.05	13.78	21.99	13.87	21.93	13.97	21.87	14.07	26
27	22.90	14.31	22.83	14.41	22.77	14.51	22.71	14.61	27
28	23.75	14.84	23.68	14.94	23.61	15.04	23.55	15.15	28
29	24.59	15.37	24.53	15.47	24.46	15.58	24.39	15.69	29
30	25.44	15.90	25.37	16.01	25.30	16.12	25.23	16.23	30
31	26.29	16.43	26.22	16.54	26.15	16.66	26.07	16.77	31
32	27.14	16.96	27.06	17.08	26.99	17.19	26.91	17.31	32
33	27.99	17.49	27.91	17.61	27.83	17.73	27.75	17.85	33
34	28.83	18.02	28.75	18.14	28.68	18.27	28.60	18.39	34
35	29.68	18.55	29.60	18.68	29.52	18.81	29.44	18.93	35
36	30.53	19.08	30.45	19.21	30.36	19.34	30.28	19.48	36
37	31.38	19.61	31.29	19.74	31.21	19.88	31.12	20.02	37
38	32.23	20.14	32.14	20.28	32.05	20.42	31.96	20.56	38
39	33.07	20.67	32.98	20.81	32.89	20.95	32.80	21.10	39
40	33.92	21.20	33.83	21.34	33.74	21.49	33.64	21.64	40
41	34.77	21.73	34.67	21.88	34.58	22.03	34.48	22.18	41
42	35.62	22.26	35.52	22.41	35.42	22.57	35.32	22.72	42
43	36.47	22.79	36.37	22.95	36.27	23.10	36.16	23.26	43
44	37.31	23.32	37.21	23.48	37.11	23.64	37.01	23.80	44
45	38.16	23.85	38.06	24.01	37.95	24.18	37.85	24.34	45
46	39.01	24.38	38.90	24.55	38.80	24.72	38.69	24.88	46
47	39.86	24.91	39.75	25.08	39.64	25.25	39.53	25.43	47
48	40.71	25.44	40.59	25.61	40.48	25.79	40.37	25.97	48
49	41.55	25.97	41.44	26.15	41.33	26.33	41.21	26.51	49
50	42.40	26.50	42.29	26.68	42.17	26.86	42.05	27.05	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	58 Deg.		57¾ Deg.		57½ Deg		57¼ Deg.		

Dist.	32 Deg.		32¼ Deg.		32½ Deg.		32¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	43.25	27.03	43.13	27.21	43.01	27.40	42.89	27.59	51
52	44.10	27.56	43.98	27.75	43.86	27.94	43.73	28.13	52
53	44.95	28.09	44.82	28.28	44.70	28.48	44.58	28.67	53
54	45.79	28.62	45.67	28.82	45.54	29.01	45.42	29.21	54
55	46,64	29.15	46.51	29.35	46.39	29.55	46.26	29.75	55
56	47.49	29.68	47.36	29.88	47.23	30.09	47.10	30.29	56
57	48.34	30.21	48.21	30.42	48.07	30.63	47.94	30.84	57
58	49.19	30.74	49.05	30.95	48.92	31.16	48.78	31.38	58
59	50.03	31.27	49.90	31.48	49.76	31.70	49.62	31.92	59
60	50.88	31.80	50.74	32.02	50.60	32.24	50.46	32.46	60
61	51.73	32.33	51.59	32.55	51.45	32.78	51.30	33.00	61
62	52.58	32.85	52.44	33.08	52.29	33.31	52.14	33.54	62
63	53.43	33.38	53.28	33.62	53.13	33.85	52.99	34.08	63
64	54.28	33.91	54.13	34.15	53.98	34.39	53.83	34.62	64
65	55.12	34.44	54.97	34.68	54.82	34.92	54.67	35.16	65
66	55.97	34.97	55.82	35.22	55.66	35.46	55.51	35.70	66
67	56.82	35.50	56.66	35.75	56.51	36.00	56.35	36.25	67
68	57.67	36.03	57.51	36.29	57.35	36.54	57.19	36.79	68
69	58.52	36.56	58.36	36.82	58.19	37.07	58.03	37.33	69
70	59.36	37.09	59.20	37.35	59.04	37.61	58.87	37.87	70
71	60.21	37.62	60.05	37.89	59.88	38.15	59.71	38.41	71
72	61.06	38.15	60.89	38.42	60.72	38.69	60.55	38.95	72
73	61.91	38.68	61.74	38.95	61.57	39.22	61.40	39.49	73
74	62.76	39.21	62.58	39.49	62.41	39.76	62.24	40.03	74
75	63,60	39.74	63.43	40.02	63.25	40.30	63.08	40.57	75
76	64.45	40.27	64.28	40.55	64.10	40.83	63.92	41.11	76
77	65.30	40.80	65.12	41.09	64.94	41.37	64.76	41.65	77
78	66.15	41.33	65.97	41.62	65.78	41.91	65.60	42.20	78
79	67.00	41.86	66.81	42.16	66.63	42.45	66.44	42.74	79
80	67.84	42.39	67.66	42.69	67.47	42.98	67.28	43.28	80
81	68.69	42.92	68.50	43.22	68.31	43.52	68.12	43.82	81
82	69.54	43.45	69.35	43.76	69.16	44.06	68.97	44.36	82
83	70.39	43.98	70.20	44.29	70.00	44.60	69.81	44.90	83
84	71.24	44.51	71.04	44.82	70.84	45.13	70.65	45.44	84
85	72.08	45.04	71.89	45.36	71.69	45.67	71.49	45.98	85
86	72.93	45.57	72.73	45.89	72.53	46.21	72.33	46.52	86
87	73.78	46.10	73.58	46.42	73.38	46.75	73.17	47.06	87
88	74.63	46.63	74.42	46.96	74.22	47.28	74.01	47.61	88
89	75.48	47.16	75.27	47.49	75.06	47.82	74.85	48.15	89
90	76.32	47.69	76.12	48.03	75.91	48.36	75.69	48.69	90
91	77.17	48.22	76.96	48.56	76.75	48.89	76.53	49.23	91
92	78.02	48.75	77.81	49.09	77.59	49.43	77.38	49.77	92
93	78.87	49.28	78.65	49.63	78.44	49.97	78.22	50.31	93
94	79.72	49.81	79.50	50.16	79.28	50.51	79.06	50.85	94
95	80.56	50.34	80.34	50.69	80.12	51.04	79.90	51.39	95
96	81.41	50.87	81.19	51.23	80.97	51.58	80.74	51.93	96
97	82.26	51.40	82.04	51.76	81.81	52.12	81.58	52.47	97
98	83.11	51.93	82.88	52.29	82.65	52.66	82.42	53.02	98
99	83.96	52.46	83.73	52.83	83.50	53.19	83.26	53.56	99
100	84.80	52.99	84.57	53.36	84.34	53.73	84.10	54.10	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	58 Deg.		57¾ Deg.		57½ Deg.		57¼ Deg.		Dist.

Dist.	33 Deg.		33¼ Deg.		33½ Deg.		33¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,84	0,54	0,84	0,55	0,83	0,55	0,83	0,56	1
2	1,68	1,09	1,67	1,10	1,67	1,10	1,66	1,11	2
3	2,52	1,63	2,51	1,64	2,50	1,66	2,49	1,67	3
4	3,35	2,18	3,35	2,19	3,34	2,21	3,33	2,22	4
5	4,19	2,72	4,18	2,74	4,17	2,76	4,16	2,78	5
6	5,03	3,27	5,02	3,29	5,00	3,31	4,99	3,33	6
7	5,87	3,81	5,85	3,84	5,84	3,86	5,82	3,89	7
8	6,71	4,36	6,69	4,39	6,67	4,42	6,65	4,44	8
9	7,55	4,90	7,53	4,93	7,50	4,97	7,48	5,00	9
10	8 39	5,45	8,36	5,48	8,34	5,52	8,31	5,56	10
11	9,23	5,99	9,20	6,03	9,17	6,07	9,15	6,11	11
12	10,06	6,54	10,04	6,58	10,01	6,62	9,98	6,67	12
13	10,90	7,08	10,87	7,13	10,84	7,18	10,81	7,22	13
14	11,74	7,62	11,71	7,68	11,67	7,73	11,64	7,78	14
15	12,58	8,17	12,54	8,22	12,51	8,28	12,47	8,33	15
16	13,42	8,71	13,38	8,77	13,34	8,83	13,30	8,89	16
17	14,26	9,26	14,22	9,32	14,18	9,38	14,13	9,44	17
18	15,10	9,80	15,05	9,87	15,01	9,93	14,97	10,00	18
19	15,93	10,35	15,89	10,42	15,84	10,49	15,80	10,56	19
20	16,77	10,89	16,73	10,97	16,68	11,04	16,63	11,11	20
21	17,61	11,44	17,56	11,51	17,51	11,59	17,46	11,67	21
22	18,45	11,98	18,40	12,06	18,35	12,14	18,29	12,22	22
23	19,29	12,53	19,23	12,61	19,18	12,69	19,12	12,78	23
24	20,13	13,07	20,07	13,16	20,01	13,25	19,96	13,33	24
25	20,97	13,62	20,91	13,71	20,85	13,80	20,79	13,89	25
26	21,81	14,16	21,74	14,26	21,68	14,35	21,62	14,44	26
27	22,64	14,71	22,58	14,80	22,51	14,90	22,45	15,00	27
28	23,48	15,25	23,42	15,35	23,35	15,45	23,28	15,56	28
29	24,32	15,79	24,25	15,90	24,18	16,01	24,11	16,11	29
30	25,16	16,34	25,09	16,45	25,02	16,56	24,94	16,67	30
31	26,00	16,88	25,92	17,00	25,85	17,11	25,78	17,22	31
32	26,84	17,43	26,76	17,55	26,68	17,66	26,61	17,78	32
33	27,68	17,97	27,60	18,09	27,52	18,21	27.44	18,33	33
34	28,51	18,52	28,43	18,64	28,35	18,77	28,27	18,89	34
35	29,35	19,06	29,27	19,19	29,19	19,32	29,10	19.44	35
36	30,19	19,61	30,11	19,74	30,02	19,87	29,93	20,00	36
37	31,03	20,15	30,94	20,29	30,85	20,42	30,76	20,56	37
38	31,87	20,70	31,78	20,84	31,69	20,97	31,60	21,11	38
39	32,71	21,24	32,62	21,38	32,52	21,53	32,43	21,67	39
40	33,55	21,79	33,45	21,93	33,36	22,08	33,26	22,22	40
41	34,39	22,33	34,29	22,48	34,19	22,63	34,09	22,78	41
42	35,22	22,87	35.12	23,03	35,02	23,18	34,92	23.33	42
43	36,06	23,42	35,96	23,58	35,86	23,73	35,75	23,89	43
44	36,90	23,96	36,80	24,12	36,69	24,29	36,58	24,45	44
45	37,74	24,51	37,63	24,67	37,52	24,84	37,42	25,00	45
46	38,58	25,05	38,47	25,22	38,36	25,39	38,25	25,56	46
47	39,42	25,60	39,31	25,77	39,19	25.94	39,08	26,11	47
48	40,26	26,14	40,14	26,32	40,03	26,49	39,91	26,67	48
49	41,09	26,69	40,98	26,87	40,86	27,04	40,74	27,22	49
50	41,93	27 23	41,81	27,41	41,69	27,60	41,57	27,78	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	57 Deg.		56¾ Deg		56½ Deg.		56¼ Deg.		

Dist.	33 Deg.		33¼ Deg.		33½ Deg.		33¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	42.77	27.78	42.65	27.96	42.53	28.15	42.40	28.33	51
52	43.61	28.32	43.49	28.51	43.36	28.70	43.24	28.89	52
53	44.45	28.87	44.32	29.06	44.20	29.25	44.07	29.45	53
54	45.29	29.41	45.16	29.61	45.03	29.80	44.90	30.00	54
55	46.13	29.96	46.00	30.16	45.86	30.36	45.73	30.56	55
56	46.97	30.50	46.83	30.70	46.70	30.91	46.56	31.11	56
57	47.80	31.04	47.67	31.25	47.53	31.46	47.39	31.67	57
58	48.64	31.59	48.50	31.80	48.37	32.01	48.23	32.22	58
59	49.48	32.13	49.34	32.35	49.20	32.56	49.06	32.78	59
60	50.32	32.68	50.18	32.90	50.03	33.12	49.89	33.33	60
61	51.16	33.22	51.01	33.45	50.87	33.67	50.72	33.89	61
62	52.00	33.77	51.85	33.99	51.70	34.22	51.55	34.45	62
63	52.84	34.31	52.69	34.54	52.53	34.77	52.38	35.00	63
64	53.67	34.86	53.52	35.09	53.37	35.32	53.21	35.56	64
65	54.51	35.40	54.36	35.64	54.20	35.88	54.05	36.11	65
66	55.35	35.95	55.19	36.19	55.04	36.43	54.88	36.67	66
67	56.19	36.49	56.03	36.74	55.87	36.98	55.71	37.22	67
68	57.03	37.04	56.87	37.28	56.70	37.53	56.54	37.78	68
69	57.87	37.58	57.70	37.83	57.54	38.08	57.37	38.33	69
70	58.71	38.12	58.54	38.38	58.37	38.64	58.20	38.89	70
71	59.55	38.67	59.38	38.93	59.21	39.19	59.03	39.45	71
72	60.38	39.21	60.21	39.48	60.04	39.74	59.87	40.00	72
73	61.22	39.76	61.05	40.03	60.87	40.29	60.70	40.56	73
74	62.06	40.30	61.89	40.57	61.71	40.84	61.53	41.11	74
75	62.90	40.85	62.72	41.12	62.54	41.40	62.36	41.67	75
76	63.74	41.39	63.56	41.67	63.38	41.95	63.19	42.22	76
77	64.58	41.94	64.39	42.22	64.21	42.50	64.02	42.78	77
78	65.42	42.48	65.23	42.77	65.04	43.05	64.85	43.33	78
79	66.25	43.03	66.07	43.32	65.88	43.60	65.69	43.89	79
80	67.09	43.57	66.90	43.86	66.71	44.15	66.52	44.45	80
81	67.93	44.12	67.74	44.41	67.54	44.71	67.35	45.00	81
82	68.77	44.66	68.58	44.96	68.38	45.26	68.18	45.56	82
83	69.61	45.20	69.41	45.51	69.21	45.81	69.01	46.11	83
84	70.45	45.75	70.25	46.06	70.05	46.36	69.84	46.67	84
85	71.29	46.29	71.08	46.60	70.88	46.91	70.67	47.22	85
86	72.13	46.84	71.92	47.15	71.71	47.47	71.51	47.78	86
87	72.96	47.38	72.76	47.70	72.55	48.02	72.34	48.33	87
88	73.80	47.93	73.59	48.25	73.38	48.57	73.17	48.89	88
89	74.64	48.47	74.43	48.80	74.22	49.12	74.00	49.45	89
90	75.48	49.02	75.27	49.35	75.05	49.67	74.83	50.00	90
91	76.32	49.56	76.10	49.89	75.88	50.23	75.66	50.56	91
92	77.16	50.11	76.94	50.44	76.72	50.78	76.50	51.11	92
93	78.00	50.65	77.77	50.99	77.55	51.33	77.33	51.67	93
94	78.83	51.20	78.61	51.54	78.39	51.88	78.16	52.22	94
95	79.67	51.74	79.45	52.09	79.22	52.43	78.99	52.78	95
96	80.51	52.29	80.28	52.64	80.05	52.99	79.82	53.33	96
97	81.35	52.83	81.12	53.18	80.89	53.54	80.65	53.89	97
98	82.19	53.37	81.96	53.73	81.72	54.09	81.48	54.45	98
99	83.03	53.92	82.79	54.28	82.55	54.64	82.32	55.00	99
100	83.87	54.46	83.63	54.83	83.39	55.19	83.15	55.56	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	57 Deg.		56¾ Deg.		56½ Deg.		56¼ Deg.		

Dift.	34 Deg.		34¼ Deg.		34½ Deg.		34¾ Deg.		Dift.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.83	0.56	0.83	0.56	0.82	0.57	0.82	0.57	1
2	1.66	1.12	1.65	1.13	1.65	1.13	1.64	1.14	2
3	2.49	1.68	2.48	1.69	2.47	1.70	2.46	1.71	3
4	3.32	2.24	3.31	2.25	3.30	2.27	3.29	2.28	4
5	4.15	2.80	4.13	2.81	4.12	2.83	4.11	2.85	5
6	4.97	3.36	4.96	3.38	4.94	3.40	4.93	3.42	6
7	5.80	3.91	5.79	3.94	5.77	3.96	5.75	3.99	7
8	6.63	4.47	6.61	4.50	6.59	4.53	6.57	4.56	8
9	7.46	5.03	7.44	5.07	7.42	5.10	7.39	5.13	9
10	8.29	5.59	8.27	5.63	8.24	5.66	8.22	5.70	10
11	9.12	6.15	9.09	6.19	9.07	6.23	9.04	6.27	11
12	9.95	6.71	9.92	6.75	9.89	6.80	9.86	6.84	12
13	10.78	7.27	10.75	7.32	10.71	7.36	10.68	7.41	13
14	11.61	7.83	11.57	7.88	11.54	7.93	11.50	7.98	14
15	12.44	8.39	12.40	8.44	12.36	8.50	12.32	8.55	15
16	13.26	8.95	13.23	9.00	13.19	9.06	13.15	9.12	16
17	14.09	9.51	14.05	9.57	14.01	9.63	13.97	9.69	17
18	14.92	10.07	14.88	10.13	14.83	10.20	14.79	10.26	18
19	15.75	10.62	15.71	10.69	15.66	10.76	15.61	10.83	19
20	16.58	11.18	16.53	11.26	16.48	11.33	16.43	11.40	20
21	17.41	11.74	17.36	11.82	17.31	11.89	17.25	11.97	21
22	18.24	12.30	18.18	12.38	18.13	12.46	18.08	12.54	22
23	19.07	12.86	19.01	12.94	18.95	13.03	18.90	13.11	23
24	19.90	13.42	19.84	13.51	19.78	13.59	19.72	13.68	24
25	20.73	13.98	20.66	14.07	20.60	14.16	20.54	14.25	25
26	21.55	14.54	21.49	14.63	21.43	14.73	21.36	14.82	26
27	22.38	15.10	22.32	15.20	22.25	15.29	22.18	15.39	27
28	23.21	15.66	23.14	15.76	23.08	15.86	23.01	15.96	28
29	24.04	16.22	23.97	16.32	23.90	16.43	23.83	16.53	29
30	24.87	16.78	24.80	16.88	24.72	16.99	24.65	17.10	30
31	25.70	17.33	25.62	17.45	25.55	17.56	25.47	17.67	31
32	26.53	17.89	26.45	18.01	26.37	18.12	26.29	18.24	32
33	27.36	18.45	27.28	18.57	27.20	18.69	27.11	18.81	33
34	28.19	19.01	28.10	19.14	28.02	19.26	27.94	19.38	34
35	29.02	19.57	28.93	19.70	28.84	19.82	28.76	19.95	35
36	29.85	20.13	29.76	20.26	29.67	20.39	29.58	20.52	36
37	30.67	20.69	30.58	20.82	30.49	20.96	30.40	21.09	37
38	31.50	21.25	31.41	21.39	31.32	21.52	31.22	21.66	38
39	32.33	21.81	32.24	21.95	32.14	22.09	32.04	22.23	39
40	33.16	22.37	33.06	22.51	32.97	22.66	32.87	22.80	40
41	33.99	22.93	33.89	23.07	33.79	23.22	33.69	23.37	41
42	34.82	23.49	34.72	23.64	34.61	23.79	34.51	23.94	42
43	35.65	24.05	35.54	24.20	35.44	24.36	35.33	24.51	43
44	36.48	24.60	36.37	24.76	36.26	24.92	36.15	25.08	44
45	37.31	25.16	37.20	25.33	37.09	25.49	36.97	25.65	45
46	38.14	25.72	38.02	25.89	37.91	26.05	37.80	26.22	46
47	38.96	26.28	38.85	26.45	38.73	26.62	38.62	26.79	47
48	39.79	26.84	39.68	27.01	39.56	27.19	39.44	27.36	48
49	40.62	27.40	40.50	27.58	40.38	27.75	40.26	27.93	49
50	41.45	27.96	41.33	28.14	41.21	28.32	41.08	28.50	50
Dift.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dift.
	56 Deg		55¾ Deg.		55½ Deg.		55 Deg.		

Dist.	34 Deg.		34¼ Deg.		34½ Deg.		34¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	42,28	28,52	42,16	28,70	42,03	28,89	41,90	29,07	51
52	43,11	29,08	42,98	29,27	42,85	29,45	42,73	29,64	52
53	43,94	29,64	43,81	29,83	43,68	30,02	43,55	30,21	53
54	44,77	30,20	44,64	30,39	44,50	30,59	44,37	30,78	54
55	45,60	30,76	45,46	30,95	45,33	31,15	45,19	31,35	55
56	46,43	31,31	46,29	31,52	46,15	31,72	46,01	31,92	56
57	47,26	31,87	47,12	32,08	46,98	32,29	46,83	32,49	57
58	48,08	32,43	47,94	32,64	47,80	32,85	47,66	33,06	58
59	48,91	32,99	48,77	33,21	48,62	33,42	48,48	33,63	59
60	49,74	33,55	49,60	33,77	49,45	33,98	49,30	34,20	60
61	50,57	34,11	50,42	34,33	50,27	34,55	50,12	34,77	61
62	51,40	34,67	51,25	34,89	51,10	35,12	50,94	35,34	62
63	52,23	35,23	52,08	35,46	51,92	35,68	51,76	35,91	63
64	53,06	35,79	52,90	36,02	52,74	36,25	52,59	36,48	64
65	53,89	36,35	53,73	36,58	53,57	36,82	53,41	37,05	65
66	54,72	36,91	54,55	37,15	54,39	37,38	54,23	37,62	66
67	55,55	37,47	55,38	37,71	55,22	37,95	55,05	38,19	67
68	56,37	38,03	56,21	38,27	56,04	38,52	55,87	38,76	68
69	57,20	38,58	57,03	38,83	56,86	39,08	56,69	39,33	69
70	58,03	39,14	57,86	39,40	57,69	39,65	57,52	39,90	70
71	58,86	39,70	58,69	39,96	58,51	40,21	58,34	40,47	71
72	59,69	40,26	59,51	40,52	59,34	40,78	59,16	41,04	72
73	60,52	40,82	60,34	41,08	60,16	41,35	59,98	41,61	73
74	61,35	41,38	61,17	41,65	60,99	41,91	60,80	42,18	74
75	62,18	41,94	61,99	42,21	61,81	42,48	61,62	42,75	75
76	63,01	42,50	62,82	42,77	62,63	43,05	62,45	43,32	76
77	63,84	43,06	63,65	43,34	63,46	43,61	63,27	43,89	77
78	64,66	43,62	64,47	43,90	64,28	44,18	64,09	44 46	78
79	65,49	44,18	65,30	44,46	65,11	44,75	64,91	45,03	79
80	66,32	44,74	66,13	45,02	65,93	45,31	65,73	45,60	80
81	67,15	45,29	66,95	45,59	66,75	45,88	66,55	46,17	81
82	67,98	45,85	67,78	46,15	67,58	46,45	67,37	46,74	82
83	68,81	46,41	68,61	46,71	68,40	47,01	68,20	47,31	83
84	69,64	46,97	69,43	47,28	69,23	47,58	69,02	47,88	84
85	70,47	47,53	70,26	47,84	70,05	48,14	69,84	48,45	85
86	71,30	48,09	71,09	48,40	70,87	48,71	70,66	49,02	86
87	72,13	48,65	71,91	48,96	71,70	49,28	71,48	49,59	87
88	72,96	49,21	72,74	49,53	72,52	49,84	72,30	50,16	88
89	73,78	49,77	73,57	50,09	73,35	50,41	73,13	50,73	89
90	74,61	50,33	74,39	50,65	74,17	50,98	73,95	51,30	90
91	75,44	50,89	75,22	51,22	75,00	51,54	74,77	51,87	91
92	76,27	51,45	76,05	51,78	75,82	52,11	75,59	52,44	92
93	77,10	52,00	76,87	52,34	76,64	52,68	76,41	53,01	93
94	77,93	52,56	77,70	52,90	77,47	53,24	77,23	53,58	94
95	78,76	53,12	78,53	53,47	78,29	53,81	78,06	54,15	95
96	79,59	53,68	79,35	54,03	79,12	54,37	78,88	54,72	96
97	80,42	54,24	80,18	54,59	79,94	54,94	79,70	55,29	97
98	81,25	54,80	81,01	55,15	80,76	55,51	80,52	55,86	98
99	82,07	55,36	81,83	55,72	81,59	56,07	81,34	56,43	99
100	82,90	55,92	82,66	56,28	82,41	56,64	82,16	57,00	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	56 Deg.		55¾ Deg.		55½ Deg.		55¼ Deg.		Dist.

Diſt.	35 Deg.		35¼ Deg.		35½ Deg.		35¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.82	0.57	0.82	0.58	0.81	0.58	0.81	0.58	1
2	1.64	1.15	1.63	1.15	1.63	1.16	1.62	1.17	2
3	2.46	1.72	2.45	1.73	2.44	1.74	2.43	1.75	3
4	3.28	2.29	3.27	2.31	3.26	2.32	3.25	2.34	4
5	4.10	2.87	4.08	2.89	4.07	2.90	4.06	2.92	5
6	4.91	3.44	4.90	3.46	4.88	3.48	4.87	3.51	6
7	5.73	4.01	5.72	4.04	5.70	4.06	5.68	4.09	7
8	6.55	4.59	6.53	4.62	6.51	4.65	6.49	4.67	8
9	7.37	5.16	7.35	5.19	7.33	5.23	7.30	5.26	9
10	8.19	5.74	8.17	5.77	8.14	5.81	8.12	5.84	10
11	9.01	6.31	8.98	6.35	8.96	6.39	8.93	6.43	11
12	9,83	6.88	9.80	6.93	9.77	6.97	9.74	7.01	12
13	10.65	7.46	10.62	7.50	10.58	7.55	10.55	7.60	13
14	11.47	8.03	11.43	8.08	11.40	8.13	11.36	8.18	14
15	12.29	8.60	12.25	8.66	12.21	8.71	12.17	8.76	15
16	13.11	9.18	13.07	9.23	13.03	9.29	12.99	9.35	16
17	13.93	9.75	13.88	9.81	13.84	9.87	13.80	9.93	17
18	14.74	10.32	14.70	10.39	14.65	10.45	14.61	10.52	18
19	15.56	10.90	15.52	10.97	15.47	11.03	15.42	11.10	19
20	16.38	11.47	16.33	11.54	16.28	11.61	16.23	11.68	20
21	17.20	12.05	17.15	12.12	17.10	12.19	17.04	12.27	21
22	18.02	12.62	17.97	12.70	17 91	12.78	17.85	12.85	22
23	18.84	13.19	18.78	13.27	18.72	13.36	18.67	13.44	23
24	19.66	13.77	19.60	13.85	19.54	13.94	19.48	14.02	24
25	20.48	14.34	20.42	14.43	20.35	14.52	20.29	14.61	25
26	21.30	14.91	21.23	15.01	21.17	15.10	21.10	15.19	26
27	22.12	15.49	22.05	15.58	21.98	15.68	21.91	15.77	27
28	22.94	16.06	22.87	16.16	22.80	16.26	22.72	16.36	28
29	23.76	16.63	23.68	16.74	23.61	16.84	23.54	16.94	29
30	24.57	17.21	24.50	17.31	24.42	17.42	24.35	17.53	30
31	25.39	17.78	25.32	17.89	25.24	18.00	25.16	18.11	31
32	26.21	18.35	26.13	18.47	26.05	18.58	25.97	18.70	32
33	27.03	18.93	26.95	19.05	26.87	19.16	26.78	19.28	33
34	27.85	19.50	27.77	19.62	27.68	19.74	27 59	19.86	34
35	28.67	20.08	28.58	20.20	28.49	20.32	28.41	20.45	35
36	29.49	20.65	29.40	20.78	29.31	20.91	29.22	21.03	36
37	30.31	21.22	30.22	21.35	30.12	21.49	30.03	21.62	37
38	31.13	21.80	31.03	21.93	30.94	22.07	30.84	22.20	38
39	31.95	22.37	31.85	22.51	31.75	22.65	31.65	22.79	39
40	32.77	22.94	32.67	23.09	32.56	23.23	32.46	23.37	40
41	33.59	23.52	33.48	23.66	33.38	23.81	33.27	23.95	41
42	34.40	24.09	34.30	24.24	34.19	24.39	34.09	24.54	42
43	35.22	24.66	35.12	24.82	35.01	24.97	34.90	25.12	43
44	36.04	25.24	35.93	25.39	35.82	25.55	35.71	25.71	44
45	36.86	25.81	36.75	25.97	36.64	26.13	36.52	26.29	45
46	37.68	26.38	37.57	26.55	37.45	26.71	37.33	26.88	46
47	38.50	26.96	38.38	27.13	38.26	27.29	38.14	27.46	47
48	39.32	27.53	39.20	27.70	39.08	27.87	38.96	28.04	48
49	40.14	28.11	40.02	28.28	39.89	28.45	39.77	28.63	49
50	40 96	28.68	40.83	28.86	40.71	29.04	40.58	29.21	50
Diſt.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diſt.
	55 Deg.		54¾ Deg.		54½ Deg.		4¼ Deg.		

Dist.	35 Deg.		35¼ Deg.		35½ Deg.		35¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	41.78	29,25	41,65	29,43	41,52	29,62	41,39	29,80	51
52	42,60	29,83	42,47	30,01	42,33	30,20	42,20	30,38	52
53	43,42	30,40	43,28	30,59	43,15	30,78	43,01	30,97	53
54	44,23	30,97	44,10	31,17	43,96	31,36	43,82	31,55	54
55	45.05	31,55	44,92	31,74	44,78	31,94	44.64	32,13	55
56	45,87	32,12	45,73	32,32	45,59	32,52	45,45	32,72	56
57	46.69	32,69	46,55	32,90	46,40	33,10	46,26	33,30	57
58	47.51	33,27	47,37	33,47	47,22	33,68	47,07	33,89	58
59	48,33	33,84	48,18	34,05	48,03	34,26	47,88	34,47	59
60	49,15	34,41	49,00	34,63	48,85	34,84	48,69	35,05	60
61	49,97	34,99	49,82	35,21	49,66	35,42	49,51	35,64	61
62	50,79	35,56	50,63	35,78	50,48	36,00	50,32	36,22	62
63	51,61	36,14	51,45	36,36	51,29	36,58	51,13	36,81	63
64	52,43	36,71	52,27	36,94	52,10	37,16	51,94	37,39	64
65	53,24	37,28	53,08	37,51	52,92	37,75	52,75	37,98	65
66	54,06	37,86	53,90	38,09	53,73	38,33	53,56	38,56	66
67	54,88	38,43	54,71	38,67	54,55	38,91	54,38	39,14	67
68	55,70	39,00	55,53	39,25	55,36	39,49	55,19	39,73	68
69	56,52	39,58	56,35	39,82	56,17	40,07	56,00	40,31	69
70	57,34	40,15	57,16	40,40	56,99	40,65	56,81	40,90	70
71	58,16	40,72	57,98	40,98	57,80	41,23	57,62	41,48	71
72	58,98	41,30	58,80	41,55	58,62	41,81	58,43	42,07	72
73	59,80	41,87	59,61	42,13	59,43	42,39	59,24	42,65	73
74	60,62	42,44	60,43	42,71	60,24	42,97	60,06	43,23	74
75	61,44	43,02	61,25	43,29	61,06	43,55	60,87	43,82	75
76	62,26	43,59	62,06	43,86	61,87	44,13	61,68	44,40	76
77	63,07	44,17	62,88	44,44	62,69	44,71	62,49	44,99	77
78	63,89	44,74	63,70	45,02	63,50	45,29	63,30	45,57	78
79	64,71	45,31	64,51	45,59	64,32	45,88	64,11	46,16	79
80	65,53	45,89	65,33	46,17	65,13	46,46	64,93	46,74	80
81	66,35	46,46	66,15	46,75	65,94	47,04	65,74	47,32	81
82	67,17	47,03	66,96	47,33	66,76	47,62	66,55	47,91	82
83	67,99	47,61	67,78	47,90	67,57	48,20	67,36	48,49	83
84	68,81	48,18	68,60	48,48	68,39	48,78	68,17	49,08	84
85	69,63	48,75	69,41	49,00	69,20	49,36	68,98	49,66	85
86	70,45	49,33	70,23	49,63	70,01	49,94	69,80	50,25	86
87	71,27	49,90	71,05	50,21	70,83	50,52	70,61	50,83	87
88	72,09	50,47	71,86	50,79	71,64	51,10	71,42	51,41	88
89	72,90	51,05	72,68	51,37	72,46	51,68	72,23	52,00	89
90	73,72	51,62	73,50	51,94	73,27	52,26	73,04	52,58	90
91	74,54	52,20	74,31	52,52	74,08	52,84	73,85	53,17	91
92	75,36	52,77	75,13	53,10	74,90	53,42	74,66	53,75	92
93	76,18	53,34	75,95	53,67	75,71	54,01	75,48	54,34	93
94	77,00	53,92	76,76	54,25	76,53	54,59	76,29	54,92	94
95	77,82	54,49	77,58	54,83	77,34	55,17	77,10	55,50	95
96	78,64	55,06	78,40	55,41	78,16	55,75	77,91	56,09	96
97	79,46	55,64	79,21	55,98	78,97	56,33	78,72	56,67	97
98	80,28	56,21	80,03	50,56	79,76	56,91	79,53	57,26	98
99	81,10	56,78	80,85	57,14	80,60	57,49	80,35	57,84	99
100	81,92	57,36	81,66	57,71	81,41	58,07	81,16	58,42	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	55 Deg.		54¾ Deg.		54½ Deg.		54¼ Deg.		Dist.

Dist.	36 Deg.		36¼ Deg.		36½ Deg.		36¼ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat	Dep.	Lat.	Dep.	
1	0.81	0.59	0.81	0.59	0.80	0.59	0.80	0.60	1
2	1.62	1.18	1.61	1.18	1.61	1.19	1.60	1.20	2
3	2.43	1.76	2.42	1.77	2.41	1.78	2.40	1.79	3
4	3.24	2.35	3.23	2.37	3.22	2.38	3.20	2.39	4
5	4.05	2.94	4.03	2.96	4.02	2.97	4.01	2.99	5
6	4.85	3.53	4.84	3.55	4.82	3.57	4.81	3.59	6
7	5.66	4.11	5.65	4.14	5.63	4.16	5.61	4.19	7
8	6.47	4.70	6.45	4.73	6.43	4.76	6.41	4.79	8
9	7.28	5.29	7.26	5.32	7.23	5.35	7.21	5.38	9
10	8.09	5.88	8.06	5.91	8.04	5.95	8.01	5.98	10
11	8.90	6.47	8.87	6.50	8.84	6.54	8.81	6.58	11
12	9,71	7.05	9.68	7.10	9.65	7.14	9.61	7.18	12
13	10.52	7.64	10.48	7.69	10.45	7.73	10.42	7.78	13
14	11.33	8.23	11.29	8.28	11.25	8.33	11.22	8.38	14
15	12.14	8.82	12.10	8.87	12.06	8.92	12.02	8.97	15
16	12.94	9.40	12.90	9.46	12.86	9.52	12.82	9.57	16
17	13.75	9.99	13.71	10.05	13.67	10.11	13.62	10.17	17
18	14.56	10.58	14.52	10.64	14.47	10.71	14.42	10.77	18
19	15.37	11.17	15.32	11.23	15.27	11.30	15.22	11.37	19
20	16.18	11.76	16.13	11.83	16.08	11.90	16.03	11.97	20
21	16.99	12.34	16.94	12.42	16.8	12.49	16.83	12.56	21
22	17.80	12.93	17.74	13.01	17 68	13.09	17.63	13.16	22
23	18.61	13.52	18.55	13.60	18.49	13.68	18.43	13.76	23
24	19.42	14.11	19.35	14.19	19.29	14.28	19.23	14.36	24
25	20.23	14.69	20.16	14.78	20.10	14.87	20.03	14.96	25
26	21.03	15.28	20.97	15.37	20.90	15.47	20.83	15.56	26
27	21.84	15.87	21.77	16.97	21.70	10.06	21.63	16.15	27
28	22.65	16.46	22.58	16.56	22.51	16.65	22.44	16.75	28
29	23.46	17.05	23.39	17.15	23.31	17.25	23.24	17.35	29
30	24.27	17.63	24.19	17.74	24.12	17.84	24.04	17.95	30
31	25.08	18.22	25.00	18.33	24.92	18.44	24.84	18.55	31
32	25.89	18.81	25.81	18.92	25.72	19.03	25.64	19.15	32
33	26.70	19.40	26.61	19.51	26.53	19.63	26.44	19.74	33
34	27.51	19.98	27.42	20.10	27.33	20.22	27.24	20.34	34
35	28.32	20.57	28.23	20.70	28.13	20.82	28.04	20.94	35
36	29.12	21.16	29.03	21.29	28.94	21.41	28.85	21.54	36
37	29.93	21.75	29.84	21.88	29.74	22.01	29.65	22.14	37
38	30.74	22.34	30.64	22.47	30.55	22.60	30.45	22.74	38
39	31.55	22.92	31.45	23.06	31.35	23.20	31.25	23.33	39
40	32.36	23.51	32.26	23.65	32.15	23.79	32.05	23.93	40
41	33.17	24.10	33.06	24.24	32.96	24.39	32.85	24.53	41
42	33.98	24.69	33.87	24.83	33.76	24.98	33.65	25.13	42
43	34.79	25.27	34.68	25.43	34.57	25.58	34.45	25.73	43
44	35.60	25.86	35.48	26.02	35.37	26.17	35.26	26.33	44
45	36.41	26.45	36.29	26.61	36.17	26.77	36.06	26.92	45
46	37.21	27.04	37.10	27.20	36.98	27.36	36.86	27.52	46
47	38.02	27.63	37.90	27.79	37.78	27.96	37.66	28.12	47
48	38.83	28.21	38.71	28.38	38.59	28.55	38.46	28.72	48
49	39.64	28.80	39.52	28.97	39.39	29.15	39.26	29.32	49
50	40.45	29.39	40.32	29.57	40.19	29.74	40.06	29.92	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	54 Deg.		53¾ Deg.		53½ Deg		53¼ Deg.		Dist.

Diſt.	36 Deg		36¼ Deg		36½ Deg		36¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	41.26	29.98	41.13	30.16	41.00	30.34	40.86	30.51	51
52	42.07	30.56	41.94	30.75	41.80	30.93	41.67	31.11	52
53	42.88	31.15	42.74	31.34	42.60	31.53	42.47	31.71	53
54	43.69	31.74	43.55	31.93	43.41	32.12	43.27	32.31	54
55	44.50	32.33	44.35	32.52	44.21	32.72	44.07	32.91	55
56	45.30	32.92	45.16	33.11	45.02	33.31	44.87	33.51	56
57	46.11	33.50	45.97	33.70	45.82	33.90	45.67	34.10	57
58	46.92	34.09	46.77	34.30	46.62	34.50	46.47	34.70	58
59	47.73	34.68	47.58	34.89	47.43	35.09	47.27	35.30	59
60	48.54	35.27	48.39	35.48	48.23	35.69	48.08	35.90	60
61	49.35	35.85	49.19	36.07	49.04	36.28	48.88	36.50	61
62	50.16	36.44	50.00	36.66	49.84	36.88	49.68	37.10	62
63	50.97	37.03	50.81	37.25	50.64	37.47	50.48	37.69	63
64	51.78	37.62	51.61	37.84	51.45	38.07	51.28	38.29	64
65	52.59	38.21	52.42	38.44	52.25	38.66	52.08	38.87	65
66	53.40	38.79	53.23	39.03	53.05	39.26	52.88	39.49	66
67	54.20	39.38	54.03	39.62	53.86	39.85	53.06	40.09	67
68	55.01	39.97	54.84	40.21	54.66	40.45	54.49	40.09	68
69	55.82	40.56	55.64	40.80	55.47	41.04	55.29	41.28	69
70	56.63	41.14	56.45	41.39	56.27	41.04	56.09	41.88	70
71	57.44	41.73	57.26	41.98	57.07	42.23	56.89	42.48	71
72	58.25	42.32	58.06	42.57	57.88	42.83	57.69	43.08	72
73	59.06	42.91	58.87	43.17	58.68	43.42	58.49	43.68	73
74	59.87	43.50	59.68	43.76	59.49	44.02	59.29	44.28	74
75	60.68	44.08	60.48	44.35	60.29	44.61	60.09	44.87	75
76	61.49	44.67	61.29	44.94	61.09	45.21	60.90	45.47	76
77	62.29	45.26	62.10	45.53	61.90	45.80	61.70	46.07	77
78	63.10	45.85	62.90	46.12	62.70	46.40	62.50	46.67	78
79	63.91	46.43	63.71	46.71	63.50	46.99	63.30	47.27	79
80	64.72	47.02	64.52	47.30	64.31	47.59	64.10	47.87	80
81	65.53	47.61	65.32	47.90	65.11	48.18	64.90	48.46	81
82	66.34	48.20	66.13	48.49	65.92	48.78	65.70	49.06	82
83	67.15	48.79	66.93	49.08	66.72	49.37	66.50	49.66	83
84	67.96	49.37	67.74	49.67	67.52	49.97	67.31	50.26	84
85	68.77	49.96	68.55	50.26	68.33	50.56	68.11	50.86	85
86	69.58	50.55	69.35	50.85	69.13	51.15	68.91	51.46	86
87	70.38	51.14	70.16	51.44	69.94	51.75	69.71	52.05	87
88	71.19	51.73	70.97	52.04	70.74	52.34	70.51	52.65	88
89	72.00	52.31	71.77	52.63	71.54	52.94	71.31	53.25	89
90	72.81	52.90	72.58	53.22	72.35	53.53	72.11	53.85	90
91	73.62	53.49	73.39	53.81	73.15	54.13	72.91	54.45	91
92	74.43	54.08	74.19	54.40	73.95	54.72	73.72	55.05	92
93	75.24	54.66	75.00	54.99	74.76	55.32	74.52	55.64	93
94	76.05	55.25	75.81	55.58	75.56	55.91	75.32	56.24	94
95	76.86	55.84	76.61	56.17	76.37	56.51	76.12	56.84	95
96	77.67	56.43	77.42	56.77	77.17	57.10	76.92	57.44	96
97	78.47	57.02	78.23	57.36	77.97	57.70	77.72	58.04	97
98	79.28	57.60	79.03	57.95	78.78	58.29	78.52	58.64	98
99	80.09	58.19	79.84	58.54	79.58	58.89	79.34	59.23	99
100	80.90	58.78	80.64	59.13	80.39	59.48	80.13	59.63	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Diſt.	54 Deg.		53¾ Deg.		53½ Deg.		53¼ Deg.		Diſt.

Dist.	37 Deg.		37¼ Deg.		37½ Deg.		37¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.80	0.60	0.80	0.61	0.79	0.61	0.79	0.61	1
2	1.60	1.20	1.59	1.21	1.59	1.22	1. 8	1.22	2
3	2.40	1.81	2.39	1.82	2.38	1.83	2.37	1.84	3
4	3.19	2.41	3.18	2.42	3.17	2.43	3.16	2.45	4
5	3.99	3.01	3.98	3.03	3.97	3.04	3.95	3.06	5
6	4.79	3.61	4.78	3.63	4.76	3.65	4.74	3.67	6
7	5.59	4.21	5.57	4.24	5.55	4.26	5.53	4.29	7
8	6.39	4.81	6.37	4.84	6.35	4.87	6.33	4.90	8
9	7.19	5.42	7.16	5.45	7.14	5.48	7.12	5.51	9
10	7.99	6.02	7.96	6.05	7.93	6.09	7.91	6.12	10
11	8.78	6.02	8.76	6.66	8.73	6.70	8.70	6.73	11
12	9.58	7.22	9.55	7.26	9.52	7.31	9.49	7.35	12
13	10.38	7.82	10.35	7.87	10.31	7.91	10.28	7.96	13
14	11.18	8.43	11.14	8.47	11.11	8.52	11.07	8.57	14
15	11.98	9.03	11.94	9.08	11.90	9.13	11.86	9.18	15
16	12.78	9.63	12.74	9.68	12.69	9.74	12.65	9.80	16
17	13.58	10.23	13.53	10.29	13.49	10.35	13.44	10.41	17
18	14.38	10.83	14.33	10.92	14.28	10.96	14.23	11.02	18
19	15.17	11.43	15.12	11.50	15.07	11.57	15.02	11.63	19
20	15.97	12.04	15.92	12.11	15.87	12.18	15.81	12.24	20
21	16.77	12.64	16.72	12.71	16.66	12.78	16.60	12.86	21
22	17.57	13.24	17.51	13.32	17.45	13.39	17.40	13.47	22
23	18.37	13.84	18.31	13.92	18.25	14.00	18.19	14.08	23
24	19.17	14.44	19.10	14.53	19.04	14.61	18.98	14.69	24
25	19.97	15.05	19.90	15.13	19.83	15.22	19.77	15.31	25
26	20.76	15.65	20.70	15.74	20.63	15.83	20.56	15.92	26
27	21.56	16.25	21.49	16.34	21.42	16.44	21.35	16.53	27
28	22.36	16.85	22.29	16.95	22.21	17.05	22.14	17.14	28
29	23.16	17.45	23.08	17.55	23.01	17.65	22.93	17.75	29
30	23.96	18.05	23.88	18.16	23.80	18.26	23.72	18.37	30
31	24.76	18.66	24.68	18.76	24.59	18.87	24.51	18.98	31
32	25.56	19.26	25.47	19.37	25.39	19.48	25.30	19.59	32
33	26.35	19.86	26.27	19.97	26.18	20.09	26.09	20.20	33
34	27.15	20.46	27.06	20.58	26.97	20.70	26.88	20.82	34
35	27.95	21.06	27.86	21.19	27.77	21.31	27.67	21.43	35
36	28.75	21.67	28.66	21.79	28.56	21.92	28.46	22.04	36
37	29.55	22.27	29.45	22.40	29.35	22.52	29.26	22.65	37
38	30.35	22.87	30.25	23.00	30.15	23.13	30.05	23.26	38
39	31.15	23.47	31.04	23.61	30.94	23.74	30.84	23.88	39
40	31.95	24.07	31.84	24.21	31.73	24.35	31.63	24.49	40
41	32.74	24.67	32.64	24.82	32.53	24.96	32.42	25.10	41
42	33.54	25.28	33.43	25.42	33.32	25.57	33.21	25.71	42
43	34.34	25.88	34.23	26.03	34.11	26.18	34.00	26.33	43
44	35.14	26.48	35.02	26.63	34.91	26.79	34.79	26.94	44
45	35.94	27.08	35.82	27.24	35.70	27.39	35.58	27.55	45
46	36.74	27.68	36.61	27.84	36.49	28.00	36.37	28.16	46
47	37.54	28.29	37.41	28.45	37.29	28.61	37.16	28.77	47
48	38.33	28.87	38.21	29.05	38.08	29.22	37.95	29.39	48
49	39.13	29.49	39.00	29.66	38.87	29.83	38.74	30.00	49
50	39.93	30.09	39.80	30.26	39.67	30.44	39.53	30.61	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	53 Deg.		52¾ Deg.		52½ Deg.		52¼ Deg.		Dist.

Dist.	37 Deg.		37¼ Deg.		37½ Deg.		37¾ Deg		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	40.73	30.69	40.60	30.87	40.46	31.05	40.33	31.22	51
52	41.53	31.29	41.39	31.48	41.25	31.66	41.12	31.84	52
53	42.33	31.90	42.19	32.08	42.05	32.26	41.91	32.45	53
54	43.13	32.50	42.98	32.69	42.84	32.87	42.70	33.06	54
55	43.92	33.10	43.78	33.29	43.63	33.48	43.49	33.67	55
56	44.72	33.70	44.58	33.90	44.43	34.09	44.28	34.28	56
57	45.52	34.30	45.37	34.50	45.22	34.70	45.07	34.90	57
58	46.32	34.91	46.17	35.11	46.01	35.31	45.86	35.51	58
59	47.12	35.51	46.96	35.71	46.81	35.92	46.65	36.12	59
60	47.92	36.11	47.76	36.32	47.60	36.53	47.44	36.73	60
61	48.72	36.71	48.56	36.92	48.39	37.13	48.23	37.35	61
62	49.52	37.31	49.35	37.53	49.19	37.74	49.02	37.96	62
63	50.31	37.91	50.15	38.13	49.98	38.35	49.81	38.57	63
64	51.11	38.52	50.94	38.74	50.77	38.96	50.60	39.18	64
65	51.91	39.12	51.74	39.34	51.57	39.57	51.39	39.79	65
66	52.71	39.72	52.54	39.95	52.36	40.18	52.19	40.41	66
67	53.51	40.32	53.33	40.55	53.15	40.79	52.98	41.02	67
68	54.31	40.92	54.13	41.16	53.95	41.40	53.77	41.63	68
69	55.11	41.53	54.92	41.77	54.74	42.00	54.56	42.24	69
70	55.90	42.13	55.72	42.37	55.53	42.61	55.35	42.86	70
71	56.70	42.73	56.52	42.98	56.33	43.22	56.14	43.47	71
72	57.50	43.33	57.31	43.58	57.12	43.83	56.93	44.08	72
73	58.30	43.93	58.11	44.19	57.91	44.44	57.72	44.69	73
74	59.10	44.53	58.90	44.79	58.71	45.05	58.51	45.30	74
75	59.90	45.14	59.70	45.40	59.50	45.66	59.30	45.92	75
76	60.70	45.74	60.50	46.00	60.29	46.27	60.09	46.53	76
77	61.49	46.34	61.29	46.61	61.09	46.87	60.88	47.14	77
78	62.29	46.94	62.09	47.21	61.88	47.48	61.67	47.75	78
79	63.09	47.54	62.88	47.82	62.67	48.09	62.46	48.37	79
80	63.89	48.15	63.68	48.42	63.47	48.70	63.26	48.98	80
81	64.69	48.75	64.48	49.03	64.26	49.31	64.05	49.59	81
82	65.49	49.35	65.27	49.63	65.05	49.92	64.84	50.20	82
83	66.29	49.95	66.07	50.24	65.85	50.53	65.63	50.81	83
84	67.09	50.55	66.86	50.84	66.64	51.14	66.42	51.43	84
85	67.88	51.15	67.66	51.45	67.43	51.74	67.21	52.04	85
86	68.68	51.76	68.46	52.06	68.23	52.35	68.00	52.65	86
87	69.48	52.36	69.25	52.66	69.02	52.96	68.79	53.26	87
88	70.28	52.96	70.05	53.27	69.82	53.57	69.58	53.88	88
89	71.08	53.56	70.84	53.87	70.61	54.18	70.37	54.49	89
90	71.88	54.16	71.64	54.48	71.40	54.79	71.16	55.10	90
91	72.68	54.77	72.44	55.08	72.20	55.40	71.95	55.71	91
92	73.47	55.37	73.23	55.69	72.99	56.01	72.74	56.32	92
93	74.27	55.97	74.03	56.29	73.78	56.61	73.53	56.94	93
94	75.07	56.57	74.82	56.90	74.58	57.22	74.32	57.55	94
95	75.87	57.17	75.62	57.50	75.37	57.83	75.12	58.16	95
96	76.67	57.77	76.42	58.11	76.16	58.44	75.91	58.77	96
97	77.47	58.38	77.21	58.71	76.96	59.05	76.70	59.39	97
98	78.27	58.98	78.01	59.32	77.75	59.66	77.49	60.00	98
99	79.06	59.58	78.80	59.92	78.54	60.27	78.28	60.61	99
100	79.86	60.18	79.60	60.53	79.34	60.88	79.07	61.22	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	53 Deg.		52¾ Deg.		52½ Deg.		52¼ Deg.		

Dist.	38 Deg.		38¼ Deg.		38½ Deg.		38¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,79	0,62	0,79	0,62	0,78	0,62	0,78	0,63	1
2	1,58	1,23	1,57	1,24	1,57	1,24	1,56	1,25	2
3	2,36	1,85	2,36	1,86	2,35	1,87	2,34	1,88	3
4	3,15	2,46	3,14	2,48	3,13	2,49	3,12	2,50	4
5	3,94	3,08	3,93	3,10	3,91	3,11	3,90	3,13	5
6	4,73	3,69	4,71	3,71	4,70	3,74	4,68	3,76	6
7	5,52	4,31	5,50	4,33	5,48	4,36	5,46	4,38	7
8	6,30	4,93	6,28	4,95	6,26	4,98	6,24	5,01	8
9	7,09	5,54	7,07	5,57	7,04	5,60	7,02	5,63	9
10	7,88	6,16	7,85	6,19	7,83	6,23	7,80	6,26	10
11	8,67	6,77	8,64	6,81	8,61	6,85	8,58	6,89	11
12	9,46	7,39	9,42	7,43	9,39	7,47	9,36	7,51	12
13	10,24	8,00	10,21	8,05	10,17	8,09	10,14	8,14	13
14	11,03	8,62	10,99	8,67	10,96	8,72	10,92	8,76	14
15	11,82	9,23	11,78	9,29	11,74	9,34	11,70	9,39	15
16	12,61	9,85	12,57	9,91	12,52	9,96	12,48	10,01	16
17	13,40	10,47	13,35	10,52	13,30	10,58	13,26	10,64	17
18	14,18	11,08	14,14	11,14	14,09	11,21	14,04	11,27	18
19	14,97	11,70	14,92	11,76	14,87	11,83	14,82	11,89	19
20	15,76	12,31	15,71	12,38	15,65	12,45	15,60	12,52	20
21	16,55	12,93	16,49	13,00	16,43	13,07	16,38	13,14	21
22	17,34	13,54	17,28	13,62	17,22	13,70	17,16	13,77	22
23	18,12	14,16	18,06	14,24	18,00	14,32	17,94	14,40	23
24	18,91	14,78	18,85	14,86	18.78	14,94	18,72	15,02	24
25	19,70	15,39	19,63	15,48	19,57	15,56	19,50	15,65	25
26	20,49	16,01	20,42	16,10	20,35	16,19	20,28	16,27	26
27	21,28	16,62	21,20	16,72	21,13	16,81	21,06	16,90	27
28	22,06	17,24	21,99	17,33	21,91	17,43	21,84	17,53	28
29	22,85	17,85	22,77	17,95	22,70	18,05	22,62	18,15	29
30	23,64	18,47	23,56	18,57	23,48	18,66	23,40	18,78	30
31	24,43	19,09	24,34	19,19	24,26	19,30	24,18	19.40	31
32	25,22	19,70	25,13	19,81	25,04	19,92	24,96	20,03	32
33	26,00	20,32	25,92	20,43	25,83	20,54	25,74	20,66	33
34	26,79	20,93	26,70	21,05	26,61	1,17	26,52	21,28	34
35	27,58	21,55	27,49	21,67	27,39	21,79	27.30	21,91	35
36	28,37	22,16	28,27	22,29	28,17	22,41	28,08	22,53	36
37	29,16	22,78	29,06	22,91	28,96	23,03	28,86	23,16	37
38	29,94	23,40	29,84	23,53	29,74	23,66	29,64	23,79	38
39	30,73	24,01	30,63	24,14	30,52	24,28	30,42	24,41	39
40	31,52	24,63	31,41	24,76	31,30	24,90	31,20	25,04	40
41	32,31	25,24	32,20	25,38	32,09	25,52	31,98	25,66	41
42	33,10	25,86	32,98	26,00	32,87	26,15	32,76	26,29	42
43	33,88	26,47	33,77	26,62	33,65	26,77	33,53	26,91	43
44	34.67	27,09	34,55	27,24	34,43	27,39	34,31	27,54	44
45	35,46	27,70	35.34	27,86	35,22	28,01	35,09	28,17	45
46	36,25	28,32	36,12	28,48	36,00	28,64	35,87	28,79	46
47	37,04	28,94	36,91	29,10	36,78	29,26	36,65	29,42	47
48	37,82	29,55	37,70	29,72	37,57	29,88	37,43	30,04	48
49	38,61	30,17	38,48	30,34	38,35	30,50	38,21	30,67	49
50	39,40	30,78	39,27	30,95	39,13	31,13	38,99	31,30	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	52 Deg.		51¾ Deg		51½ Deg.		51¼ Deg.		

Dist.	38 Deg.		38¼ Deg.		38½ Deg.		38¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	40.19	31.40	40.05	31.57	39.91	31.75	39.77	31.92	51
52	40.98	32.01	40.84	32.19	40.70	32.37	40.55	32.55	52
53	41.76	32.63	41.62	32.81	41.48	32.99	41.33	33.17	53
54	42.55	33.25	42.41	33.43	42.26	33.62	42.11	33.80	54
55	43.34	33.86	43.19	34.05	43.04	34.24	42.89	34.43	55
56	44.13	34.48	43.98	34.67	43.83	34.86	43.67	35.05	56
57	44.92	35.09	44.76	35.29	44.61	35.48	44.45	35.68	57
58	45.70	35.71	45.55	35.91	45.39	36.11	45.23	36.30	58
59	46,49	36.32	46.33	36.53	46.17	36.73	46.01	36.93	59
60	47,28	36.94	47.12	37.15	46.96	37.35	46.79	37.56	60
61	48.07	37.56	47.90	37.76	47.74	37.97	47.57	38.18	61
62	48.86	38.17	48.69	38.38	48.52	38.60	48.35	38.81	62
63	49.64	38.79	49.47	39.00	49.30	39.22	49.13	39.43	63
64	50.43	39.40	50.26	39.62	50.09	39.84	49.91	40.06	64
65	51.22	40.02	51.05	40.24	50.87	40.46	50.69	40.68	65
66	52.01	40.63	51.83	40.86	51.65	41.09	51.47	41.31	66
67	52,80	41.25	52.62	41.48	52.43	41.71	52.25	41.94	67
68	53.58	41.86	53.40	42.10	53.22	42.33	53.03	42.56	68
69	54.37	42.48	54.19	42.72	54.00	42.95	53.81	43.19	69
70	55.16	43.10	54.97	43.34	54.78	43.58	54.59	43.81	70
71	55.95	43.71	55.76	43.96	55.57	44.20	55.37	44.44	71
72	56.74	44.33	56.54	44.57	56.35	44.82	56.15	45.07	72
73	57,52	44.94	57.33	45.19	57.13	45.44	56.93	45.69	73
74	58.31	45.56	58.11	45.81	57.91	46.07	57.71	46.32	74
75	59.10	46.17	58.90	46.43	58.70	46.69	58.49	46.94	75
76	59.89	46.79	59.68	47.05	59.48	47.31	59.27	47.57	76
77	60.68	47.41	60.47	47.67	60.26	47.93	60.05	48.20	77
78	61.46	48.02	61.25	48.29	61.04	48.56	60.83	48.82	78
79	62.25	48.64	62.04	48.91	61.83	49.18	61.61	49.45	79
80	63,04	49.25	62.83	49.53	62.61	49.80	62.39	50.07	80
81	63.83	49.87	63.61	50.15	63.39	50.42	63.17	50.70	81
82	64.62	50.48	64.40	50.77	64.17	51.05	63.95	51.33	82
83	65.40	51.10	65.18	51.38	64.96	51.67	64.73	51.95	83
84	66.19	51.72	65.97	52.00	65.74	52.29	65.51	52.58	84
85	66.98	52.33	66.75	52.62	66.52	52.91	66.29	53.20	85
86	67.77	52.95	67.54	53.24	67.30	53.54	67.07	53.83	86
87	68.56	53.56	68.32	53.86	68.09	54.16	67.85	54.46	87
88	69.34	54.18	69.11	54.48	68.87	54.78	68.63	55.08	88
89	70.13	54.79	69.89	55.10	69.65	55.40	69.41	55.71	89
90	70.92	55.41	70.68	55.72	70.43	56.03	70.19	56.33	90
91	71.71	56.03	71.46	56.34	71.22	56.65	70.97	56.96	91
92	72,50	56.64	72.25	56.96	72.00	57.27	71.75	57.58	92
93	73.28	57.26	73.03	57.58	72.78	57.89	72.53	58.21	93
94	74.07	57.87	73.82	58.19	73.57	58.52	73.31	58.84	94
95	74.86	58.49	74.61	58.81	74.35	59.14	74.09	59.46	95
96	75.65	59.10	75.39	59.43	75.13	59.76	74.87	60.09	96
97	76.44	59.72	76.18	60.05	75.91	60.38	75.65	60.71	97
98	77.22	60.33	76.96	60.67	76.70	61.01	76.43	61.34	98
99	78.01	60.95	77.75	61.29	77.48	61.63	77.21	61.97	99
100	78.80	61.57	78.53	61.91	78.26	62.25	77.99	62.59	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	52 Deg.		51¾ Deg.		51½ Deg.		51¼ Deg.		

Dist.	39 Deg.		39¼ Deg		39½ Deg.		39¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.78	0.63	0.7	0.63	0.77	0.64	0.77	0.64	1
2	1.5	1.26	1.55	1.27	1.54	1.27	1.54	1.28	2
3	2.33	1.89	2.32	1.90	2.31	1.91	2.31	1.92	3
4	3.11	2.52	3.10	2.53	3.09	2.54	3.08	2.56	4
5	3.89	3.15	3.87	3.16	3.86	3.18	3.84	3.20	5
6	4.66	3.78	4.65	3.80	4.63	3.82	4.61	3.84	6
7	5.44	4.41	5.42	4.43	5.40	4.45	5.38	4.48	7
8	6.22	5.03	6.2	5.06	6.17	5.09	6.15	5.12	8
9	6.99	5.66	6.97	5.69	6.94	5.72	6.92	5.75	9
10	7.77	6.29	7.7	6.33	7.72	6.36	7.69	6.39	10
11	8.55	6.92	8.52	6.96	8.49	7.00	8.46	7.03	11
12	9.33	7.55	9.29	7.59	9.26	7.63	9.23	7.67	12
13	10.10	8.18	10.07	8.23	10.03	8.27	9.99	8.31	13
14	10.88	8.81	10.84	8.86	10.80	8.91	10.76	8.95	14
15	11.66	9.44	11.62	9.49	11.57	9.54	11.53	9.59	15
16	12.43	10.07	12.39	10.12	12.35	10.18	12.30	10.23	16
17	13.21	10.70	13.16	10.76	13.12	10.81	13.07	10.87	17
18	13.99	11.33	13.94	11.39	13.89	11.45	13.84	11.51	18
19	14.77	11.96	14.71	12.02	14.66	12.09	14.61	12.15	19
20	15.54	12.59	15.49	12.65	15.43	12.72	15.38	12.79	20
21	16.32	13.22	16.26	13.29	16.20	13.36	16.15	13.43	21
22	17.10	13.84	17.04	13.92	16.98	13.99	16.91	14.07	22
23	17.87	14.47	17.81	14.55	17.75	14.63	17.68	14.71	23
24	18.65	15.10	18.59	15.18	18.52	15.27	18.45	15.35	24
25	19.43	15.73	19.36	15.82	19.29	15.90	19.22	15.99	25
26	20.21	16.36	20.13	16.45	20.06	16.54	19.99	16.63	26
27	20.98	16.99	20.91	17.08	20.83	17.17	20.76	17.26	27
28	21.76	17.62	21.68	17.72	21.61	17.81	21.53	17.90	28
29	22.54	18.25	22.46	18.35	22.38	18.45	22.30	18.54	29
30	23.31	18.88	23.23	18.98	23.15	19.08	23.07	19.18	30
31	24.09	19.51	24.01	19.61	23.92	19.72	23.83	19.82	31
32	24.87	20.14	24.78	20.25	24.69	20.35	24.60	20.46	32
33	25.65	20.77	25.55	20.88	25.46	20.99	25.37	21.10	33
34	26.42	21.40	26.33	21.51	26.24	21.63	26.14	21.74	34
35	27.20	22.03	27.10	22.14	27.01	22.26	26.91	22.38	35
36	27.98	22.66	27.88	22.78	27.78	22.90	27.68	23.02	36
37	28.75	23.28	28.65	23.41	28.55	23.53	28.45	23.66	37
38	29.53	23.91	29.43	24.04	29.32	24.17	29.22	24.30	38
39	30.31	24.54	30.20	24.68	30.09	24.81	29.98	24.94	39
40	31.09	25.17	30.98	25.31	30.86	25.44	30.75	25.58	40
41	31.86	25.80	31.75	25.94	31.64	26.08	31.52	26.22	41
42	32.64	26.43	32.52	26.57	32.41	26.72	32.29	26.86	42
43	33.42	27.06	33.30	27.21	33.18	27.35	33.06	27.50	43
44	34.19	27.69	34.07	27.84	33.95	27.99	33.83	28.14	44
45	34.97	28.32	34.85	28.47	34.72	28.62	34.60	28.77	45
46	35.75	28.95	35.62	29.10	35.49	29.26	35.37	29.41	46
47	36.53	29.5	36.40	29.74	36.27	29.90	36.14	30.05	47
48	37.30	30.21	37.17	30.37	37.04	30.53	36.90	30.69	48
49	38.08	30.84	37.95	31.00	37.81	31.17	37.67	31.33	49
50	38.86	31.47	38.74	31.64	38.58	31.80	38.44	31.97	50
Dist.	Dep.	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	51 Deg.		50¾ Deg.		50½ Deg.		50¼ Deg		

Dift.	39 Deg.		39¼ Deg.		39½ Deg.		39¾ Deg.		Dift.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	39.63	32.10	39.49	32.27	39.35	32.44	39.21	32.61	51
52	40.41	32.72	40.27	32.90	40.12	33.08	39.98	33.25	52
53	41.19	33.35	41.04	33.53	40.90	33.71	40.75	33.89	53
54	41.97	33.98	41.82	34.17	41.67	34.35	41.52	34.53	54
55	42.74	34.61	42.59	34.80	42.44	34.98	42.29	35.17	55
56	43.52	35.24	43.37	35.43	43.21	35.62	43.06	35.81	56
57	44.30	35.87	44.14	36.06	43.98	36.26	43.82	36.45	57
58	45.07	36.50	44.91	36.70	44.75	36.89	44.59	37.09	58
59	45.85	37.13	45.69	37.33	45.53	37.53	45.36	37.73	59
60	46,63	37.76	46.46	37.95	46.30	38.16	46.13	38.37	60
61	47,41	38.39	47.24	38.60	47.07	38.80	46.90	39.01	61
62	48.18	39.02	48.01	39.23	47.84	39.44	47.67	39.65	62
63	48.96	39.65	48.79	39.86	48.61	40.07	48.44	40.28	63
64	49.74	40.28	49.56	40.49	49.38	40.71	49.21	40.92	64
65	50.51	40.91	50.34	41.13	50.16	41.35	49.97	41.56	65
66	51.29	41.54	51.11	41.76	50.93	41.98	50.74	42.20	66
67	52.07	42.16	51.88	42.39	51.70	42.62	51.51	42.84	67
68	52,85	42.79	52.66	43.02	52.47	43.25	52.28	43.48	68
69	53.52	43.42	53.43	43.66	53.24	43.89	53.05	44.12	69
70	54.40	44.05	54.21	44.29	54.01	44.53	53.82	44.76	70
71	55.18	44.68	54.98	44.92	54.79	45.16	54.59	45.40	71
72	55.95	45.31	55.76	45.55	55.56	45.80	55.36	46.04	72
73	56.73	45.94	56.53	46.19	56.33	46.43	56.13	46.68	73
74	57,51	46.57	57.31	46.82	57.10	47.07	56.89	47.32	74
75	58.29	47.20	58.08	47.45	57.87	47.71	57.66	47.96	75
76	59.06	47.83	58.85	48.09	58.64	48.34	58.43	48.60	76
77	59.84	48.46	59.63	48.72	59.42	48.98	59.20	49.24	77
78	60.62	49.09	60.40	49.35	60.19	49.61	59.97	49.88	78
79	61.39	49.72	61.18	49.98	60.96	50.25	60.74	50.52	79
80	62.17	50.35	61.95	50.62	61.73	50.89	61.51	51.16	80
81	62,95	50.97	62.73	51.25	62.50	51.52	62.28	51.79	81
82	63.73	51.60	63.50	51.88	63.27	52.16	63.04	52.43	82
83	64.50	52.23	64.27	52.51	64.04	52.79	63.81	53.07	83
84	65.28	52.86	65.05	53.15	64.82	53.43	64.58	53.71	84
85	66.06	53.49	65.82	53.78	65.59	54.07	65.35	54.35	85
86	66.83	54.12	66.60	54.41	66.36	54.70	66.12	54.99	86
87	67.61	54.75	67.37	55.05	67.13	55.34	66.89	55.63	87
88	68.39	55.38	68.15	55.68	67.90	55.97	67.66	56.27	88
89	69.17	56.01	68.92	56.32	68.67	56.61	68.43	56.91	89
90	69.94	56.64	69.70	56.94	69.45	57.25	69.20	57.55	90
91	70.72	57.27	70.47	57.58	70.22	57.88	69.96	58.19	91
92	71.50	57.90	71.24	58.21	70.99	58.52	70.73	58.83	92
93	72,27	58.53	72.02	58.84	71.76	59.16	71.50	59.47	93
94	73.05	59.16	72.79	59.47	72.53	59.79	72.27	60.11	94
95	73.83	59.79	73.57	60.11	73.30	60.43	73.04	60.75	95
96	74.61	60.41	74.34	60.74	74.08	61.06	73.81	61.39	96
97	75.38	61.04	75.12	61.37	74.85	61.70	74.58	62.03	97
98	76.16	61.67	75.89	62.01	75.62	62.34	75.35	62.66	98
99	76.94	62.30	76.66	62.64	76.39	62.97	76.12	63.30	99
100	77.71	62.93	77.44	63.27	77.16	63.61	76.88	63.94	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dift.	51 Deg.		50¾ Deg.		50½ Deg.		50¼ Deg.		Dift.

Dist.	40 Deg.		40¼ Deg		40½ Deg.		40¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.77	0.64	0.76	0.65	0.76	0.65	0.76	0.65	1
2	1.53	1.29	1.53	1.29	1.52	1.30	1.52	1.31	2
3	2.30	1.93	2.29	1.94	2.28	1.95	2.27	1.96	3
4	3.06	2.57	3.05	2.58	3.04	2.60	3.03	2.61	4
5	3.83	3.21	3.82	3.23	3.80	3.25	3.79	3.26	5
6	4.60	3.86	4.58	3.88	4.56	3.90	4.55	3.92	6
7	5.36	4.50	5.34	4.52	5.32	4.55	5.30	4.57	7
8	6.13	5.14	6.11	5.17	6.08	5.20	6.06	5.22	8
9	6.89	5.79	6.87	5.82	6.84	5.84	6.82	5.87	9
10	7.66	6.43	7.63	6.46	7.60	6.49	7.58	6.53	10
11	8.43	7.07	8.40	7.11	8.36	7.14	8.33	7.18	11
12	9.19	7.71	9.16	7.75	9.12	7.79	9.09	7.83	12
13	9.96	8.36	9.92	8.40	9.89	8.44	9.85	8.49	13
14	10.72	9.00	10.69	9.05	10.65	9.09	10.61	9.14	14
15	11.49	9.64	11.45	9.69	11.41	9.74	11.36	9.79	15
16	12.26	10.28	12.21	10.34	12.17	10.39	12.12	10.44	16
17	13.02	10.93	12.97	10.98	12.93	11.04	12.88	11.10	17
18	13.79	11.57	13.74	11.63	13.69	11.69	13.64	11.75	18
19	14.55	12.21	14.50	12.28	14.45	12.34	14.39	12.40	19
20	15.32	12.86	15.26	12.92	15.21	12.99	15.15	13.06	20
21	16.09	13.50	16.03	13.57	15.97	13.64	15.91	13.71	21
22	16.85	14.14	16.79	14.21	16.73	14.29	16.67	14.36	22
23	17.62	14.78	17.55	14.86	17.49	14.94	17.42	15.01	23
24	18.39	15.43	18.32	15.51	18.25	15.59	18.18	15.67	24
25	19.15	16.07	19.08	16.15	19.01	16.24	18.94	16.32	25
26	19.92	16.71	19.84	16.80	19.77	16.89	19.70	16.97	26
27	20.68	17.36	20.61	17.45	20.53	17.54	20.45	17.62	27
28	21.45	18.00	21.37	18.09	21.29	18.18	21.21	18.28	28
29	22.22	18.64	22.13	18.74	22.05	18.83	21.97	18.93	29
30	22.98	19.28	22.90	19.38	22.81	19.48	22.73	19.58	30
31	23.75	19.93	23.66	20.03	23.57	20.13	23.48	20.24	31
32	24.51	20.57	24.42	20.68	24.33	20.78	24.24	20.89	32
33	25.28	21.21	25.19	21.32	25.09	21.43	25.00	21.54	33
34	26.05	21.85	25.95	21.97	25.85	22.08	25.76	22.19	34
35	26.81	22.50	20.71	22.61	26.61	22.73	26.51	22.85	35
36	27.58	23.14	27.48	23.26	27.37	23.38	27.27	23.50	36
37	28.34	23.78	28.24	23.91	28.13	24.03	28.03	24.15	37
38	29.11	24.43	29.00	24.55	28.90	24.68	28.79	24.80	38
39	29.88	25.07	29.77	25.20	29.66	25.33	29.54	25.46	39
40	30.64	25.71	30.53	25.84	30.42	25.98	30.30	26.11	40
41	31.41	26.35	31.29	26.49	31.18	26.63	31.06	26.76	41
42	32.17	27.00	32.06	27.14	31.94	27.28	31.62	27.42	42
43	32.94	27.64	32.82	27.78	32.70	27.93	32.58	28.07	43
44	33.71	28.28	33.58	28.43	33.46	28.58	33.33	28.72	44
45	34.47	28.93	34.35	29.06	34.22	29.23	34.09	29.37	45
46	35.24	29.57	35.11	29.72	34.98	29.87	34.85	30.03	46
47	36.00	30.21	35.87	30.37	35.74	30.52	35.61	30.68	47
48	36.77	30.85	36.64	31.01	36.50	31.17	36.36	31.33	48
49	37.54	31.50	37.40	31.66	37.26	31.82	37.12	31.99	49
50	38.30	32.14	38.10	32.31	38.02	32.47	37.88	32.64	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	50 Deg.		49¾ Deg.		49½ Deg.		49¼ Deg		

Dist.	40 Deg.		40¼ Deg.		40½ Deg.		40¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	39.07	32.78	38.92	32.95	38.78	33.12	38.64	33.29	51
52	39.83	33.42	39.69	33.60	39.54	33.77	39.39	33.94	52
53	40.60	34.07	40.45	34.24	40.30	34.42	40.15	34.60	53
54	41.37	34.71	41.21	34.89	41.06	35.07	40.91	35.25	54
55	42.13	35.35	41.98	35.54	41.82	35.72	41.67	35.90	55
56	42.90	36.00	42.74	36.18	42.58	36.37	42.42	36.55	56
57	43.66	36.64	43.50	36.83	43.34	37.02	43.18	37.21	57
58	44.43	37.28	44.27	37.48	44.10	37.67	43.94	37.86	58
59	45.20	37.92	45.03	38.12	44.86	38.32	44.70	38.51	59
60	45.96	38.57	45.79	38.77	45.62	38.97	45.45	39.17	60
61	46,73	39.21	46.56	39.41	46.38	39.62	46.21	39.82	61
62	47.49	39.85	47.32	40.06	47.15	40.27	46.97	40.47	62
63	48.26	40.50	48.08	40.71	47.91	40.92	47.73	41.12	63
64	49.03	41.14	48.85	41.35	48.67	41.56	48.48	41.78	64
65	49.79	41.78	49.61	42.00	49.43	42.21	49.24	42.43	65
66	50.56	42.42	50.37	42.64	50.19	42.86	50.00	43.08	66
67	51.32	43.07	51.14	43.29	50.95	43.51	50.76	43.73	67
68	52.09	43.71	51.90	43.94	51.71	44.16	51.51	44.39	68
69	52.86	44.35	52.66	44.58	52.47	44.81	52.27	45.04	69
70	53.62	45.00	53.43	45.23	53.23	45.46	53.03	45.69	70
71	54.39	45.64	54.19	45.87	53.99	46.11	53.79	46.35	71
72	55.16	46.28	54.95	46.52	54.75	46.76	54.54	47.00	72
73	55.92	46.92	55.72	47.17	55.51	47.41	55.30	47.65	73
74	56.69	47.57	56.48	47.81	56.27	48.06	56.06	48.30	74
75	57.45	48.21	57.24	48.46	57.03	48.71	56.82	48.96	75
76	58.22	48.85	58.01	49.11	57.79	49.36	57.57	49.61	76
77	58.99	49.49	58.77	49.75	58.55	50.01	58.33	50.26	77
78	59.75	50.14	59.53	50.40	59.31	50.66	59.09	50.92	78
79	60.52	50.78	60.30	51.04	60.07	51.31	59.85	51.57	79
80	61.28	51.42	61.06	51.69	60.83	51.96	60.61	52.22	80
81	62.05	52.07	61.82	52.34	61.59	52.61	61.36	52.87	81
82	62,82	52.71	62.59	52.98	62.35	53.25	62.12	53.53	82
83	63.58	53.35	63.35	53.63	63.11	53.90	62.88	54.18	83
84	64.35	53.99	64.11	54.27	63.87	54.55	63.64	54.83	84
85	65.11	54.64	64.87	54.92	64.63	55.20	64.39	55.48	85
86	65.88	55.28	65.64	55.57	65.39	55.85	65.15	56.14	86
87	66.65	55.92	66.40	56.21	66.16	56.50	65.91	56.79	87
88	67.41	56.57	67.16	56.86	66.92	57.15	66.67	57.44	88
89	68.18	57.21	67.93	57.50	67.68	57.80	67.42	58.10	89
90	68.94	57.85	68.69	58.15	68.44	58.45	68.18	58.75	90
91	69.71	58.49	69.45	58.80	69.20	59.10	68.94	59.40	91
92	70.48	59.14	70.22	59.44	69.96	59.75	69.70	60.05	92
93	71.24	59.78	70.98	60.09	70.72	60.40	70.45	60.71	93
94	72.01	60.42	71.74	60.74	71.48	61.05	71.21	61.36	94
95	72.77	61.06	72.51	61.38	72.24	61.70	71.97	62.01	95
96	73.54	61.71	73.27	62.03	73.00	62.35	72.73	62.66	96
97	74.31	62.35	74.03	62.67	73.76	63.00	73.48	63.32	97
98	75.07	62.99	74.80	63.32	74.52	63.65	74.24	63.97	98
99	75.84	63.64	75.56	63.97	75.28	64.30	75.00	64.62	99
100	76.60	64.28	76.32	64.61	76.04	64.94	75.76	65.28	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	50 Deg.		49¾ Deg.		49½ Deg.		49¼ Deg.		

Dist.	41 Deg.		41¼ Deg.		41½ Deg.		41¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0,75	0,66	0,75	0,66	0,75	0,66	0,75	0,67	1
2	1,51	1,31	1,50	1,32	1,50	1,33	1,49	1,33	2
3	2,26	1,97	2,26	1,98	2,25	1,99	2,24	2,00	3
4	3,02	2,62	3,01	2,64	3,00	2,65	2,98	2,66	4
5	3,77	3,28	3,76	3,30	3,74	3,31	3,73	3,33	5
6	4,53	3,94	4,51	3,96	4,49	3,98	4,48	4,00	6
7	5,28	4,59	5,26	4,62	5,24	4,64	5,22	4,66	7
8	6,04	5,25	6,01	5,27	5,99	5,30	5,97	5,33	8
9	6,79	5,90	6,77	5,93	6,74	5,96	6,71	5,99	9
10	7,55	6,56	7,52	6,59	7,49	6,63	7,46	6,66	10
11	8,30	7,22	8,27	7,25	8,24	7,29	8,21	7,32	11
12	9,06	7,87	9,02	7,91	8,99	7,95	8,95	7,99	12
13	9.81	8,53	9,77	8,57	9,74	8,61	9,70	8,66	13
14	10,57	9,18	10,53	9,23	10,49	9,28	10,44	9,32	14
15	11,32	9,84	11,28	9,89	11,23	9,94	11,19	9,99	15
16	12,08	10,50	12,03	10,55	11,98	10,60	11,94	10,65	16
17	12,83	11,15	12,78	11,21	12,73	11,26	12,68	11,32	17
18	13,58	11,81	13,53	11,87	13,48	11,93	13,43	11,99	18
19	14,34	12,47	14,28	12,53	14,23	12,59	14,18	12,65	19
20	15,09	13,12	15,04	13,19	14,98	13,25	14,92	13,32	20
21	15,85	13,78	15,79	13,85	15,73	13,91	15,67	13,98	21
22	16,60	14,43	16,54	14,51	16,48	14,58	16,41	14,65	22
23	17,36	15,09	17,29	15,16	17,23	15,24	17,16	15,32	23
24	18,11	15,75	18,04	15,82	17,97	15,90	17,91	15,98	24
25	18,87	16,40	18,80	16,48	18,72	16,57	18,65	16,65	25
26	19,62	17,06	19,55	17,14	19,47	17,23	19,40	17,31	26
27	20,38	17,71	20,30	17,80	20,22	17,89	20,14	17,98	27
28	21,13	18,37	21,05	18,46	20,97	18,55	20,89	18,64	28
29	21,89	19,03	21,80	19,12	21,72	19,22	21,64	19,31	29
30	22,64	19,68	22,56	19,78	22,47	19,88	22,38	19.98	30
31	23,40	20,34	23,31	20,44	23,22	20,54	23,13	20,64	31
32	24,15	20,99	24,06	21,10	23,97	21,20	23,87	21,31	32
33	24.91	21,65	24,81	21,76	24,72	21,87	24,62	21,97	33
34	25,66	22,31	25,56	22,42	25,46	22,53	25,37	22,64	34
35	26,41	22,96	26,31	23,08	26,21	23,19	26,11	23,31	35
36	27,17	23,62	27,07	23,74	26,96	23,85	26,86	23,97	36
37	27,92	24,27	27,82	24,40	27,71	24,52	27.60	24,64	37
38	28,68	24,93	28,57	25,06	28,46	25,18	28,35	25,30	38
39	29,43	25,59	29,32	25,71	29,21	25,84	29,10	25,97	39
40	30,19	26,24	30,07	26,37	29,96	26,50	29,84	26,64	40
41	30,94	26,90	30,83	27,03	30,71	27,17	30,59	27,30	41
42	31,70	27,55	31,58	27,69	31,46	27,83	31,33	27,97	42
43	32,45	28,21	32,33	28,35	32,21	28,49	32,08	28,63	43
44	33,21	28,87	33,08	29,01	32,95	29,16	32,83	29,30	44
45	33,96	29,52	33,83	29,67	33,70	29,82	33,57	29,97	45
46	34,72	30,18	34,58	30,33	34,45	30,48	34,32	30,63	46
47	35,47	30,83	35·34	30,99	35,20	31,14	35,06	31,30	47
48	36,23	31,49	36,09	31,65	35,95	31,81	35,81	31,96	48
49	36,98	32,15	36,84	32,31	36,70	32,47	36,56	32,63	49
50	37,74	32,80	37,59	32,97	37,45	33,13	37,30	33,29	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	49 Deg.		48¾ Deg		48½ Deg.		48¼ Deg.		

Dist.	41 Deg.		41¼ Deg.		41½ Deg.		41¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	38.49	33.46	38.34	33.63	38.20	33.79	38.05	33.96	51
52	39.24	34.12	39.10	34.29	38.95	34.46	38.79	34.63	52
53	40.00	34.77	39.85	34.95	39.69	35.12	39.54	35.29	53
54	40.75	35.43	40.60	35.60	40.44	35.78	40.29	35.96	54
55	41.51	36.08	41.35	36.26	41.19	36.44	41.03	36.62	55
56	42.26	36.74	42.10	36.92	41.94	37.11	41.78	37.29	56
57	43.02	37.40	42.85	37.58	42.69	37.77	42.53	37.96	57
58	43.77	38.05	43.61	38.24	43.44	38.43	43.27	38.62	58
59	44.53	38.71	44.36	38.90	44.19	39.09	44.02	39.29	59
60	45.28	39.36	45.11	39.56	44.94	39.76	44.76	39.95	60
61	46.04	40.02	45.86	40.22	45.69	40.42	45.51	40.62	61
62	46.79	40.68	46.61	40.88	46.44	41.08	46.26	41.28	62
63	47.55	41.33	47.37	41.54	47.18	41.75	47.00	41.95	63
64	48.30	41.99	48.12	42.20	47.93	42.41	47.75	42.62	64
65	49.06	42.64	48.87	42.86	48.68	43.07	48.49	43.28	65
66	49.81	43.30	49.62	43.52	49.43	43.73	49.24	43.95	66
67	50.57	43.96	50.37	44.18	50.18	44.40	49.99	44.61	67
68	51.32	44.61	51.13	44.84	50.93	45.06	50.73	45.28	68
69	52.07	45.27	51.88	45.49	51.68	45.72	51.48	45.95	69
70	52.83	45.92	52.63	46.15	52.43	46.38	52.22	46.61	70
71	53.58	46.58	53.38	46.81	53.18	47.05	52.97	47.28	71
72	54.34	47.24	54.13	47.47	53.92	47.71	53.72	47.94	72
73	55.09	47.89	54.88	48.13	54.67	48.37	54.46	48.61	73
74	55.85	48.55	55.64	48.79	55.42	49.03	55.21	49.28	74
75	56.60	49.20	56.39	49.45	56.17	49.70	55.95	49.94	75
76	57.36	49.86	57.14	50.11	56.92	50.36	56.70	50.61	76
77	58.11	50.52	57.89	50.77	57.67	51.02	57.45	51.27	77
78	58.87	51.17	58.64	51.43	58.42	51.68	58.19	51.94	78
79	59.62	51.83	59.40	52.09	59.17	52.35	58.94	52.60	79
80	60.38	52.48	60.15	52.75	59.92	53.01	59.68	53.27	80
81	61.13	53.14	60.90	53.41	60.67	53.67	60.43	53.94	81
82	61.89	53.80	61.65	54.07	61.41	54.33	61.18	54.60	82
83	62.64	54.45	62.40	54.73	62.16	55.00	61.92	55.27	83
84	63.40	55.11	63.15	55.38	62.91	55.66	62.67	55.93	84
85	64.15	55.76	63.91	56.04	63.66	56.32	63.41	56.60	85
86	64.90	56.42	64.66	56.70	64.41	56.99	64.16	57.27	86
87	65.66	57.08	65.41	57.36	65.16	57.65	64.91	57.93	87
88	66.41	57.73	66.16	58.02	65.91	58.31	65.65	58.60	88
89	67.17	58.39	66.91	58.68	66.66	58.97	66.40	59.26	89
90	67.92	59.05	67.67	59.34	67.41	59.64	67.15	59.93	90
91	68.68	59.70	68.42	60.00	68.15	60.30	67.89	60.60	91
92	69.43	60.36	69.17	60.66	68.90	60.96	68.64	61.26	92
93	70.19	61.01	69.92	61.32	69.65	61.62	69.38	61.93	93
94	70.94	61.67	70.67	61.98	70.40	62.29	70.13	62.59	94
95	71.70	62.33	71.42	62.64	71.15	62.95	70.88	63.26	95
96	72.45	62.98	72.18	63.30	71.90	63.61	71.64	63.92	96
97	73.21	63.64	72.93	63.96	72.65	64.27	72.37	64.59	97
98	73.96	64.29	73.68	64.62	73.40	64.94	73.11	65.26	98
99	74.72	64.95	74.43	65.28	74.15	65.60	73.86	65.92	99
100	75.47	65.61	75.18	65.93	74.90	66.26	74.61	66.59	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	49 Deg.		4 ¾ Deg.		48½ Deg.		48¼ Deg.		

Dist.	42 Deg.		42¼ Deg.		42½ Deg.		42¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.74	0.67	0.74	0.67	0.74	0.68	0.73	0.68	1
2	1.49	1.34	1.48	1.34	1.47	1.35	1.47	1.36	2
3	2.23	2.01	2.22	2.02	2.21	2.03	2.20	2.04	3
4	2.97	2.68	2.96	2.69	2.95	2.70	2.94	2.72	4
5	3.72	3.35	3.70	3.36	3.69	3.38	3.67	3.39	5
6	4.46	4.01	4.44	4.03	4.42	4.05	4.41	4.07	6
7	5.20	4.68	5.18	4.71	5.16	4.73	5.14	4.75	7
8	5.95	5.35	5.92	5.38	5.90	5.40	5.87	5.43	8
9	6.69	6.02	6.66	6.05	6.64	6.08	6.61	6.11	9
10	7.43	6.69	7.40	0.72	7.37	6.76	7.34	6.79	10
11	8.17	7.36	8.14	7.40	8.11	7.43	8.08	7.47	11
12	8.92	8.03	8.88	8.07	8.85	8.11	8.81	8.15	12
13	9.66	8.70	9.62	8.74	9.58	8.78	9.55	8.82	13
14	10.40	9.37	10.36	9.41	10.32	9.46	10.28	9.50	14
15	11.15	10.04	11.10	10.09	11.06	10.13	11.01	10.18	15
16	11.89	10.71	11.84	10.76	11.80	10.81	11.75	10.86	16
17	12.63	11.38	12.58	11.43	12.53	11.48	12.48	11.54	17
18	13.38	12.04	13.32	12.10	13.27	12.16	13.22	12.22	18
19	14.12	12.71	14.06	12.77	14.01	12.84	13.95	12.90	19
20	14.86	13.38	14.80	13.45	14.75	13.51	14.69	13.58	20
21	15.61	14.05	15.54	14.12	15.48	14.19	15.42	14.25	21
22	16.35	14.72	16.28	14.79	16.22	14.86	16.16	14.93	22
23	17.09	15.39	17.02	15.46	16.96	15.54	16.89	15.61	23
24	17.84	16.06	17.77	10.14	17.69	16.21	17.62	16.29	24
25	18.58	16.73	18.51	16.81	18.43	16.89	18.36	16.97	25
26	19.32	17.40	19.25	17.48	19.17	17.57	19.09	17.65	26
27	20.06	18.07	19.99	18.15	19.91	18.24	19.83	18.33	27
28	20.81	18.74	20.73	18.83	20.64	18.92	20.56	19.01	28
29	21.55	19.40	21.47	19.50	21.38	19.59	21.30	19.69	29
30	22.29	20.07	22.21	20.17	22.12	20.27	22.03	20.36	30
31	23.04	20.74	22.95	20.84	22.86	20.94	22.76	21.04	31
32	23.78	21.41	23.69	21.52	23.59	21.62	23.50	21.72	32
33	24.52	22.08	24.43	22.19	24.33	22.29	24.23	22.40	33
34	25.27	22.75	25.17	22.86	25.07	22.97	24.97	23.08	34
35	26.01	23.42	25.91	23.53	25.80	23.65	25.70	23.76	35
36	26.75	24.09	26.65	24.21	26.54	24.32	26.44	24.44	36
37	27.50	24.70	27.39	24.88	27.28	25.00	27.17	25.12	37
38	28.24	25.43	28.13	25.55	28.02	25.67	27.90	25.79	38
39	28.98	26.10	28.87	26.22	28.75	26.35	28.64	26.47	39
40	29.73	26.77	29.61	26.89	29.49	27.02	29.37	27.15	40
41	30.47	27.43	30.35	27.57	30.23	27.70	30.11	27.83	41
42	31.21	28.10	31.09	28.24	30.97	28.37	30.84	28.51	42
43	31.96	28.77	31.83	28.91	31.70	29.05	31.58	29.19	43
44	32.70	29.44	32.57	29.58	32.44	29.73	32.31	29.87	44
45	33.44	30.11	33.31	30.26	33.18	30.40	33.04	30.55	45
46	34.18	30.78	34.05	30.93	33.91	31.08	33.78	31.22	46
47	34.93	31.45	34.79	31.60	34.65	31.75	34.51	31.90	47
48	35.67	32.12	35.53	32.27	35.39	32.43	35.25	32.58	48
49	36.41	32.79	36.27	32.95	36.13	33.10	35.98	33.26	49
50	37.16	33.46	37.01	33.62	36.86	33.78	36.72	33.94	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	48 Deg.		47¾ Deg.		47½ Deg.		47¼ Deg.		

Dist.	42 Deg.		42¼ Deg.		42½ Deg.		42¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	37,90	34,13	37,75	34,29	37,60	34,46	37,45	34,62	51
52	38,64	34,79	38,49	34,96	38,34	35,13	38,18	35,30	52
53	39,39	35,46	39,23	35,64	39,08	35,81	38,92	35,98	53
54	40,13	36,13	39,97	36,31	39,81	36,48	39,65	36,66	54
55	40,87	36,80	40,71	36,98	40,55	37,16	40,39	37,33	55
56	41,62	37,47	41,45	37,65	41,29	37,83	41,12	38,01	56
57	42,36	38,14	42,19	38,32	42,02	38,51	41,86	38,69	57
58	43,10	38,81	42,93	39,00	42,76	39,18	42,59	39,37	58
59	43,85	39,48	43,67	39,67	43,50	39,86	43,32	40,05	59
60	44,59	40,15	44,41	40,34	44,24	40,54	44,06	40,73	60
61	45,33	40,82	45,15	41,01	44,97	41,21	44,79	41,41	61
62	46,07	41,49	45,89	41,69	45,71	41,89	45,53	42,09	62
63	46,82	42,16	46,63	42,36	46,45	42,56	46,26	42,76	63
64	47,56	42,82	47,37	43,03	47,19	43,24	47,00	43,44	64
65	48,30	43,49	48,11	43,70	47,92	43,91	47,73	44,12	65
66	49,05	44,16	48,85	44,38	48,66	44,59	48,47	44,80	66
67	49,79	44,83	49,59	45,05	49,40	45,26	49,20	45,48	67
68	50,53	45,50	50,33	45,72	50,13	45,94	49,93	46,16	68
69	51,28	46,17	51,07	46,39	50,87	46,62	50,67	46,84	69
70	52,02	46,84	51,82	47,07	51,61	47,29	51,40	47,52	70
71	52,76	47,51	52,56	47,74	52,35	47,97	52,14	48,19	71
72	53,51	48,18	53,30	48,41	53,08	48,64	52,87	48,87	72
73	54,25	48,85	54,04	48,08	53,82	49,32	53,61	49,55	73
74	54,99	49,52	54,78	49,76	54,56	49,99	54,34	50,23	74
75	55,74	50,18	55,52	50,43	55,30	50,67	55,07	50,91	75
76	56,48	50,85	56,26	51,10	56,03	51,34	55,81	51,59	76
77	57,22	51,52	57,00	51,77	56,77	52,02	56,54	52,27	77
78	57,97	52,19	57,74	52,44	57,51	52,70	57,28	52,95	78
79	58,71	52,86	58,48	53,12	58,24	53,37	58,01	53,63	79
80	59,45	53,53	59,22	53,79	58,98	54,05	58,75	54,30	80
81	60,19	54,20	59,96	54,46	59,72	54,72	59,48	54,98	81
82	60,94	54,87	60,70	55,13	60,46	55,40	60,21	55,66	82
83	61,68	55,54	61,44	55,81	61,19	56,07	60,95	56,34	83
84	62,42	56,21	62,18	56,48	61,93	56,75	61,68	57,02	84
85	63,17	56,88	62,92	57,15	62,67	57,43	62,42	57,70	85
86	63,91	57,55	63,66	57,82	63,41	58,10	63,15	58,38	86
87	64,65	58,21	64,40	58,50	64,14	58,78	63,89	59,06	87
88	65,40	58,88	65,14	59,17	64,88	59,45	64,62	59,73	83
89	66,14	59,55	65,88	59,84	65,62	60,13	65,35	60,41	89
90	66,88	60,22	66,62	60,51	66,35	60,80	66,09	61,09	90
91	67,63	60,89	67,36	61,19	67,09	61,48	66,82	61,77	91
92	68,37	61,56	68,10	61,86	67,83	62,15	67,56	62,45	92
93	69,11	62,23	68,84	62,53	68,57	62,83	68,29	63,13	93
94	69,86	62,90	69,58	63,20	69,30	63,51	69,03	53,81	94
95	70,60	63,57	70,32	63,87	70,04	64,18	69,76	64,49	95
96	71,34	64,24	71,06	64,55	70,78	64,86	70,49	65,16	96
97	72,08	64,91	71,80	65,22	71,52	65,53	71,23	65,84	97
98	72,83	65,57	72,54	65,89	72,25	66,21	71,96	66,52	98
99	73,57	66,24	73,28	66,56	72,99	66,88	72,70	67,20	99
100	74,31	66,91	74,02	67,24	73,73	67,56	73,43	67,88	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	48 Deg.		47¾ Deg.		47½ Deg.		47¼ Deg.		

Diſt.	43 Deg.		43¼ Deg.		43½ Deg.		43¾ Deg.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.73	0.68	0.73	0.69	0.73	0.69	0.72	0.69	1
2	1.46	1.36	1.46	1.37	1.45	1.38	1.44	1.38	2
3	2.19	2.05	2.19	2.06	2.18	2.07	2.17	2.07	3
4	2.93	2.73	2.91	2.74	2.90	2.75	2.89	2.77	4
5	3.66	3.41	3.64	3.43	3.63	3.44	3.61	3.46	5
6	4.39	4.09	4.37	4.11	4.35	4.13	4.33	4.15	6
7	5.12	4.77	5.10	4.80	5.08	4.82	5.06	4.84	7
8	5.85	5.46	5.83	5.48	5.80	5.51	5.78	5.53	8
9	6.58	6.14	6.56	6.17	6.53	6.20	6.50	6.22	9
10	7.31	7.82	7.28	6.85	7.25	6.88	7.22	6.92	10
11	8.04	7.50	8.01	7.54	7.98	7.57	7.95	7.61	11
12	8.78	8.18	8.74	8.22	8.70	8.26	8.67	8.30	12
13	9.51	8.87	9.47	8.91	9.43	8.95	9.39	8.99	13
14	10.24	9.55	10.20	9.59	10.16	9.64	10.11	9.68	14
15	10.97	10.23	10.93	10.28	10.88	10.33	10.84	10.37	15
16	11.70	10.91	11.65	10.96	11.61	11.01	11.56	11.06	16
17	12.43	11.59	12.38	11.65	12.33	11.70	12.28	11.76	17
18	13.16	12.28	13.11	12.33	13.06	12.39	13.00	12.45	18
19	13.90	12.96	13.84	13.02	13.78	13.08	13.72	13.14	19
20	14.63	13.64	14.57	13.70	14.51	13.77	14.45	13.83	20
21	15.36	14.32	15.30	14.39	15.23	14.46	15.17	14.52	21
22	16.09	15.00	16.02	15.07	15.96	15.14	15.89	15.21	22
23	16.82	15.69	16.75	15.76	16.68	15.83	16.61	15.90	23
24	17.55	16.37	17.48	16.44	17.41	16.52	17.34	16.60	24
25	18.28	17.05	18.21	17.13	18.13	17.21	18.06	17.29	25
26	19.02	17.73	18.94	17.81	18.86	17.90	18.78	17.98	26
27	19.75	18.41	19.67	18.50	19.59	18.59	19.50	18.67	27
28	20.48	19.10	20.39	19.19	20.31	19.27	20.23	19.36	28
29	21.21	19.78	21.12	19.87	21.04	19.96	20.95	20.05	29
30	21.94	20.46	21.85	20.56	21.76	20.65	21.67	20.75	30
31	22.67	21.14	22.58	21.24	22.49	21.34	22.39	21.44	31
32	23.40	21.82	23.31	21.93	23.21	22.03	23.12	22.13	32
33	24.13	22.51	24.04	22.61	23.94	22.72	23.84	22.82	33
34	24.87	23.19	24.76	23.30	24.66	23.40	24.56	23.51	34
35	25.60	23.87	25.49	23.98	25.39	24.09	25.28	24.20	35
36	26.33	24.55	26.22	24.67	26.11	24.78	26.01	24.89	36
37	27.06	25.23	26.95	25.35	26.84	25.47	26.73	25.59	37
38	27.79	25.92	27.68	26.04	27.56	26.16	27.45	26.28	38
39	28.52	26.60	28.41	26.72	28.29	26.85	28.17	26.97	39
40	29.25	27.28	29.13	27.41	29.01	27.53	28.89	27.66	40
41	29.99	27.96	29.86	28.09	29.74	28.22	29.62	28.35	41
42	30.72	28.64	30.59	28.78	30.47	28.91	30.34	29.04	42
43	31.45	29.33	31.32	29.46	31.19	29.60	31.06	29.74	43
44	32.18	30.01	32.05	30.15	31.92	30.29	31.78	30.43	44
45	32.91	30.69	32.78	30.83	32.64	30.98	32.51	31.12	45
46	33.64	31.37	33.51	31.52	33.37	31.66	33.23	31.81	46
47	34.37	32.05	34.23	32.20	34.09	32.35	33.95	32.50	47
48	35.10	32.74	34.96	32.89	34.82	33.04	34.67	33.19	48
49	35.84	33.42	35.69	33.57	35.54	33.73	35.40	33.88	49
50	36.56	34.10	36.42	34.26	36.27	34.42	36.12	34.58	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Diſt.	47 Deg.		46¾ Deg.		46½ Deg.		46¼ Deg.		Diſt.

Dist.	43 Deg.		43¼ Deg.		43½ Deg.		43¾ Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	37.30	34.78	37.15	34.94	36.99	35.11	36.84	35.27	51
52	38.03	35.46	37.88	35.63	37.72	35.79	37.56	35.96	52
53	38.76	36.15	38.60	36.31	38.44	36.48	38.29	36.65	53
54	39.49	36.83	39.33	37.00	39.17	37.17	39.01	37.34	54
55	40.22	37.51	40.06	37.69	39.90	37.86	39.73	38.03	55
56	40.96	38.19	40.79	38.37	40.62	38.55	40.45	38.72	56
57	41.69	38.87	41.52	39.06	41.35	39.24	41.17	39.42	57
58	42.42	39.56	42.25	39.74	42.07	39.92	41.90	40.11	58
59	43.15	40.24	42.97	40.43	42.80	40.61	42.62	40.80	59
60	43.88	40.92	43.70	41.11	43.52	41.30	43.34	41.49	60
61	44.61	41.60	44.43	41.80	44.25	41.99	44.06	42.18	61
62	45.34	42.28	45.16	42.48	44.97	42.68	44.79	42.87	62
63	46.08	42.97	45.89	43.17	45.70	43.37	45.51	43.57	63
64	46.81	43.65	46.62	43.85	46.42	44.05	46.23	44.26	64
65	47.54	44.33	47.34	44.54	47.15	44.74	46.95	44.95	65
66	48.27	45.01	48.07	45.22	47.87	45.43	47.68	45.64	66
67	49.00	45.69	48.80	45.91	48.60	46.12	48.40	46.33	67
68	49.73	46.38	49.53	46.59	49.33	46.81	49.12	47.02	68
69	50.46	47.06	50.26	47.28	50.05	47.50	49.84	47.71	69
70	51.19	47.74	50.99	47.96	50.78	48.18	50.57	48.41	70
71	51.93	48.42	51.71	48.65	51.50	48.87	51.29	49.10	71
72	52.66	49.10	52.44	49.33	52.23	49.56	52.01	49.79	72
73	53.39	49.79	53.17	50.02	52.95	50.25	52.73	50.48	73
74	54.12	50.47	53.90	50.70	53.68	50.94	53.45	51.17	74
75	54.85	51.15	54.63	51.39	54.40	51.63	54.18	51.86	75
76	55.58	51.83	55.36	52.07	55.13	52.31	54.90	52.55	76
77	56.31	52.51	56.08	52.76	55.85	53.00	55.62	53.25	77
78	57.05	53.20	56.81	53.44	56.58	53.69	56.34	53.94	78
79	57.78	53.88	57.54	54.13	57.30	54.38	57.07	54.63	79
80	58.51	54.56	58.27	54.81	58.03	55.07	57.79	55.32	80
81	59.24	55.24	59.00	55.50	58.76	55.76	58.51	56.01	81
82	59.97	55.92	59.73	56.18	59.48	56.45	59.23	56.70	82
83	60.70	56.61	60.45	56.87	60.21	57.13	59.96	57.40	83
84	61.43	57.29	61.18	57.56	60.93	57.82	60.68	58.09	84
85	62.17	57.97	61.91	58.24	61.66	58.51	61.40	58.78	85
86	62.90	58.65	62.64	58.93	62.38	59.20	62.12	59.47	86
87	63.63	59.33	63.37	59.61	63.11	59.89	62.85	60.16	87
88	64.36	60.02	64.10	60.30	63.83	60.58	63.57	60.85	88
89	65.09	60.70	64.82	60.98	64.56	61.26	64.29	61.54	89
90	65.82	61.38	65.55	61.67	65.28	61.95	65.01	62.24	90
91	66.55	62.06	66.28	62.35	66.01	62.64	65.74	62.93	91
92	67.28	62.74	67.01	63.04	66.73	63.33	66.46	63.62	92
93	68.02	63.43	67.74	63.72	67.46	64.02	67.18	64.31	93
94	68.75	64.11	68.47	64.41	68.19	64.71	67.90	65.00	94
95	69.48	64.79	69.20	65.09	68.91	65.39	68.62	65.69	95
96	70.21	65.47	69.92	65.78	69.64	66.08	69.35	66.39	96
97	70.94	66.15	70.65	66.46	70.36	66.77	70.07	67.08	97
98	71.67	66.84	71.38	67.15	71.09	67.46	70.79	67.77	98
99	72.40	67.52	72.11	67.83	71.81	68.15	71.51	68.46	99
100	73.14	68.20	72.84	68.52	72.54	68.84	72.24	69.15	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	47 Deg.		46¾ Deg.		46½ Deg.		46¼ Deg		Dist.

Dist.	44 Deg.		44¼ Deg.		44½ Deg.		44¾ Deg.		45 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.72	0.69	0.72	0.70	0.71	0.70	0.71	0.71	0.71	0.71	1
2	1.44	1.39	1.43	1.40	1.43	1.40	1.42	1.41	1.41	1.41	2
3	2.16	2.08	2.15	2.09	2.14	2.10	2.13	2.11	2.12	2.12	3
4	2.88	2.78	2.87	2.79	2.85	2.80	2.84	2.82	2.83	2.83	4
5	3.60	3.47	3.58	3.49	3.57	3.50	3.55	3.52	3.54	3.54	5
6	4.32	4.17	4.30	4.19	4.28	4.21	4.26	4.22	4.24	4.24	6
7	5.04	4.86	5.01	4.88	4.99	4.91	4.97	4.93	4.95	4.95	7
8	5.75	5.56	5.73	5.58	5.71	5.61	5.68	5.63	5.66	5.66	8
9	6.47	6.25	6.45	6.28	6.42	6.31	6.39	6.34	6.36	6.36	9
10	7.19	6.95	7.16	6.98	7.13	7.01	7.10	7.04	7.07	7.07	10
11	7.91	7.64	7.88	7.68	7.85	7.71	7.81	7.74	7.78	7.78	11
12	8.63	8.34	8.60	8.37	8.56	8.41	8.52	8.45	8.49	8.49	12
13	9.35	9.03	9.31	9.07	9.27	9.11	9.23	9.15	9.19	9.19	13
14	10.07	9.73	10.03	9.77	9.99	9.81	9.94	9.86	9.90	9.90	14
15	10.79	10.42	10.74	10.47	10.70	10.51	10.65	10.56	10.61	10.61	15
16	11.51	11.11	11.46	11.16	11.41	11.21	11.36	11.26	11.31	11.31	16
17	12.23	11.81	12.18	11.86	12.13	11.92	12.07	11.97	12.02	12.02	17
18	12.95	12.50	12.89	12.56	12.84	12.62	12.78	12.67	12.73	12.73	18
19	13.67	13.20	13.61	13.26	13.55	13.32	13.49	13.38	13.43	13.43	19
20	14.39	13.89	14.33	13.96	14.26	14.02	14.20	14.08	14.14	14.14	20
21	15.11	14.59	15.04	14.65	14.98	14.72	14.91	14.78	14.85	14.85	21
22	15.83	15.28	15.76	15.35	15.69	15.42	15.62	15.49	15.56	15.56	22
23	16.54	15.98	16.47	16.05	16.40	16.12	16.33	16.19	16.26	16.26	23
24	17.26	16.67	17.19	16.75	17.12	16.82	17.04	16.90	16.97	16.97	24
25	17.98	17.37	17.91	17.44	17.83	17.52	17.75	17.60	17.68	17.68	25
26	18.70	18.06	18.62	18.14	18.54	18.22	18.46	18.30	18.38	18.38	26
27	19.42	18.76	19.34	18.84	19.26	18.92	19.17	19.01	19.09	19.09	27
28	20.14	19.45	20.06	19.54	19.97	19.63	19.89	19.71	19.80	19.80	28
29	20.86	20.15	20.77	20.24	20.68	20.33	20.60	20.42	20.51	20.51	29
30	21.58	20.84	21.49	20.93	21.40	21.03	21.31	21.12	21.21	21.21	30
31	22.30	21.53	22.21	21.63	22.11	21.73	22.02	21.82	21.92	21.92	31
32	23.02	22.23	22.92	22.33	22.82	22.43	22.73	22.53	22.63	22.63	32
33	23.74	22.92	23.64	23.03	23.54	23.13	23.44	23.23	23.33	23.33	33
34	24.46	23.62	24.35	23.72	24.25	23.83	24.15	23.94	24.04	24.04	34
35	25.18	24.31	25.07	24.42	24.96	24.53	24.86	24.64	24.75	24.75	35
36	25.90	25.01	25.79	25.12	25.68	25.23	25.57	25.34	25.46	25.46	36
37	26.62	25.70	26.50	25.82	26.39	25.93	26.28	26.05	26.16	26.16	37
38	27.33	26.40	27.22	26.52	27.10	26.63	26.99	26.75	26.87	26.87	38
39	28.05	27.09	27.94	27.21	27.82	27.34	27.70	27.46	27.58	27.58	39
40	28.77	27.79	28.65	27.91	28.53	28.04	28.41	28.16	28.28	28.28	40
41	29.49	28.48	29.37	28.61	29.24	28.74	29.12	28.86	28.99	28.99	41
42	30.21	29.18	30.08	29.31	29.96	29.44	29.83	29.57	29.70	29.70	42
43	30.93	29.87	30.80	30.00	30.67	30.14	30.54	30.27	30.41	30.41	43
44	31.65	30.56	31.52	30.70	31.38	30.84	31.25	30.98	31.11	31.11	44
45	32.37	31.26	32.23	31.40	32.10	31.54	31.96	31.68	31.82	31.82	45
46	33.09	31.95	32.95	32.10	32.81	32.24	32.67	32.38	32.53	32.53	46
47	33.81	32.65	33.67	32.80	33.52	32.94	33.38	33.09	33.23	33.23	47
48	34.53	33.34	34.38	33.49	34.24	33.64	34.09	33.79	33.94	33.94	48
49	35.25	34.04	35.10	34.19	34.95	34.34	34.80	34.50	34.65	34.65	49
50	35.97	34.73	35.82	34.89	35.66	35.05	35.51	35.20	35.36	35.36	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	46 Deg.		45¾ Deg.		45½ Deg.		45¼ Deg.		45 Deg.		

Dist.	44 Deg.		44¼ Deg.		44½ Deg.		44¾ Deg.		45 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	36.69	35.43	36.53	35.59	36.38	35.75	36.22	35.90	36.06	36.06	51
52	37.41	36.12	37.25	36.29	37.09	36.45	36.93	36.61	36.77	36.77	52
53	38.12	36.82	37.96	36.98	37.80	37.15	37.64	37.31	37.48	37.48	53
54	38.84	37.51	38.68	37.68	38.52	37.85	38.35	38.02	38.18	38.18	54
55	39.56	38.21	39.40	38.38	39.23	38.55	39.06	38.72	38.89	38.89	55
56	40.28	38.90	40.11	39.08	39.94	39.25	39.77	39.42	39.60	39.60	56
57	41.00	39.60	40.83	39.77	40.66	39.95	40.48	40.13	40.31	40.31	57
58	41.72	40.29	41.55	40.47	41.37	40.65	41.19	40.83	41.01	41.01	58
59	42.44	40.98	42.26	41.17	42.08	41.35	41.90	41.54	41.72	41.72	59
60	43.16	41.68	42.98	41.87	42.79	42.05	42.61	42.24	42.43	42.43	60
61	43.88	42.37	43.69	42.57	43.51	42.76	43.32	42.94	43.13	43.13	61
62	44.60	43.07	44.41	43.26	44.22	43.46	44.03	43.65	43.84	43.84	62
63	45.32	43.76	45.13	43.96	44.93	44.16	44.74	44.35	44.55	44.55	63
64	46.04	44.46	45.84	44.66	45.65	44.86	45.45	45.06	45.25	45.25	64
65	46.76	45.15	46.56	45.36	46.36	45.56	46.16	45.76	45.96	45.96	65
66	47.48	45.85	47.28	46.05	47.07	46.26	46.87	46.46	46.67	46.67	66
67	48.20	46.54	47.99	46.75	47.79	46.96	47.58	47.17	47.38	47.38	67
68	48.92	47.24	48.71	47.45	48.50	47.66	48.29	47.87	48.08	48.08	68
69	49.63	47.93	49.42	48.15	49.21	48.36	49.00	48.58	48.79	48.79	69
70	50.35	48.63	50.14	48.85	49.93	49.06	49.71	49.28	49.50	49.50	70
71	51.07	49.32	50.86	49.54	50.64	49.76	50.42	49.98	50.20	50.20	71
72	51.79	50.02	51.57	50.24	51.35	50.47	51.13	50.69	50.91	50.91	72
73	52.51	50.71	52.29	50.94	52.07	51.17	51.84	51.39	51.62	51.62	73
74	53.23	51.40	53.01	51.64	52.78	51.87	52.55	52.10	52.33	52.33	74
75	53.95	52.10	53.72	52.33	53.49	52.57	53.26	52.80	53.03	53.03	75
76	54.67	52.79	54.44	53.03	54.21	53.27	53.97	53.51	53.74	53.74	76
77	55.39	53.49	55.16	53.73	54.92	53.97	54.68	54.21	54.45	54.45	77
78	56.11	54.18	55.87	54.43	55.63	54.67	55.39	54.91	55.15	55.15	78
79	56.83	54.88	56.59	55.13	56.35	55.37	56.10	55.62	55.86	55.86	79
80	57.55	55.57	57.30	55.82	57.06	56.07	56.81	56.32	56.57	56.57	80
81	58.27	56.27	58.02	56.52	57.77	56.77	57.52	57.03	57.28	57.28	81
82	58.99	56.96	58.74	57.22	58.49	57.47	58.24	57.73	57.98	57.98	82
83	59.71	57.66	59.45	57.92	59.20	58.18	58.95	58.43	58.69	58.69	83
84	60.42	58.35	60.17	58.61	59.91	58.88	59.66	59.14	59.40	59.40	84
85	61.14	59.05	60.89	59.31	60.63	59.58	60.37	59.84	60.10	60.10	85
86	61.86	59.74	61.60	60.01	61.34	60.28	61.08	60.55	60.81	60.81	86
87	62.58	60.44	62.32	60.71	62.05	60.98	61.79	61.25	61.52	61.52	87
88	63.30	61.13	63.03	61.41	62.77	61.68	62.50	61.95	62.23	62.23	88
89	64.02	61.82	63.75	62.10	63.48	62.38	63.21	62.66	62.93	62.93	89
90	64.74	62.52	64.47	62.80	64.19	63.08	63.92	63.36	63.64	63.64	90
91	65.46	63.21	65.18	63.50	64.91	63.78	64.63	64.07	64.35	64.35	91
92	66.18	63.91	65.90	64.20	65.62	64.48	65.34	64.77	65.05	65.05	92
93	66.90	64.60	66.62	64.89	66.33	65.18	66.05	65.47	65.76	65.76	93
94	67.62	65.30	67.33	65.59	67.05	65.89	66.76	66.18	66.47	66.47	94
95	68.34	65.99	68.05	66.29	67.76	66.59	67.47	66.88	67.18	67.18	95
96	69.06	66.69	68.76	66.99	68.47	67.29	68.18	67.59	67.88	67.88	96
97	69.78	67.38	69.48	67.69	69.19	67.99	68.89	68.29	68.59	68.59	97
98	70.50	68.08	70.20	68.38	69.90	68.69	69.60	68.99	69.30	69.30	98
99	71.21	68.77	70.91	69.08	70.61	69.39	70.31	69.70	70.00	70.00	99
100	71.93	69.47	71.63	69.78	71.33	70.09	71.02	70.40	70.71	70.71	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	46 Deg.		45¾ Deg.		45½ Deg.		45¼ Deg.		45 Deg.		

A

TABLE

OF

LOGARITHMS,

FROM 1 TO 10,000.

Note, The index of the logarithm of every integer number conſiſting of only one figure is 0, of two figures 1, of three figures 2, of 4 figures 3; being always an unit leſs than the number of figures contained in the integer number. In this table, as is generally the caſe, the index to the logarithm of every number above 100 is omitted; yet in the operation muſt be prefixed according to this remark; ſo the logarithm of 700 is 2,84510, and of 7000 is 3,84510, and ſo of the reſt.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.00000	21	1.32222	41	1.61278	61	1.78533	81	1.90849
2	0.30103	22	34242	42	62325	62	79239	82	91381
3	0.47712	23	36173	43	63347	63	79934	83	91908
4	0.60206	24	38021	44	64345	64	80618	84	92428
5	0.69897	25	39794	45	65321	65	81291	85	92942
6	0.77815	26	41497	46	66276	66	81954	86	93450
7	0.84510	27	43136	47	67210	67	82607	87	93952
8	0.90309	28	44716	48	68124	68	83251	88	94448
9	0.95424	29	46240	49	69020	69	83885	89	94939
10	1.00000	30	47712	50	69897	70	84510	90	95424
11	1.04139	31	1.49136	51	1.70757	71	1.85126	91	1.95904
12	07918	32	50515	52	71600	72	85733	92	96379
13	11394	33	51851	53	72428	73	86332	93	96848
14	14613	34	53148	54	73239	74	86923	94	97313
15	17609	35	54407	55	74036	75	87506	95	97772
16	20412	36	55630	56	74819	76	88081	96	98227
17	23045	37	56820	57	75587	77	88649	97	98677
18	25527	38	57978	58	76343	78	89209	98	99123
19	27875	39	59106	59	77085	79	89763	99	99564
20	30103	40	60206	60	77815	80	90309	100	2.00000

No	0	1	2	3	4	5	6	7	8	9
100	00000	00043	00087	00130	00173	00217	00260	00303	00346	00389
101	00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
102	00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
103	01284	01326	01368	01410	01452	01494	01536	01578	01620	01661
104	01703	01745	01787	01828	01870	01912	01953	01995	02036	02077
105	02119	02166	02202	02243	02284	02325	02366	02407	02449	02490
106	02531	02572	02612	02653	02694	02735	02776	02816	02857	02898
107	02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
108	03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
109	03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
110	04139	04179	04218	04257	04297	04336	04375	04415	04454	04493
111	04532	04571	04610	04649	04688	04727	04766	04805	04844	04883
112	04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
113	05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
114	05690	05729	05767	05805	05843	05880	05918	05956	05994	06032
115	06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
116	06446	06483	06521	06558	06595	06633	06670	06707	06744	06781
117	06819	06856	06893	06930	06967	07004	07041	07078	07114	07151
118	07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
119	07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
120	07918	07954	07990	08027	08063	08099	08135	08171	08207	08243
121	08279	08314	08350	08386	08422	08458	08493	08529	08565	08600
122	08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
123	08991	09026	09061	09097	09131	09167	09202	09237	09272	09307
124	09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
125	09691	09726	09760	09795	09830	09864	09899	09933	09968	10003
126	10037	10071	10106	10140	10175	10209	10243	10278	10312	10346
127	10380	10414	10449	10483	10517	10551	10585	10619	10653	10687
128	10721	10755	10789	10823	10856	10890	10924	10958	10992	11025
129	11059	11093	11126	11160	11193	11227	11260	11294	11327	11361
130	11394	11428	11461	11494	11528	11561	11594	11628	11661	11694
131	11727	11760	11793	11826	11860	11893	11926	11959	11991	12024
132	12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
133	12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
134	12710	12743	12775	12808	12840	12872	12904	12937	12969	13001
135	13033	13065	13098	13130	13162	13194	13226	13258	13290	13322
136	13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
137	13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
138	13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
139	14301	14333	14364	14395	14426	14457	14488	14520	14551	14582
140	14613	14644	14675	14706	14737	14768	14798	14829	14860	14891
141	14922	14953	14983	15014	15045	15076	15106	15137	15168	15198
142	15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
143	15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
144	15836	15866	15896	15927	15957	15987	16017	16047	16077	16107
145	16137	16167	16197	16227	16256	16286	16316	16346	16376	16405
146	16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
147	16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
148	17026	17055	17085	17114	17143	17173	17202	17231	17260	17289
149	17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
150	17609	17638	17667	17696	17725	17754	17782	17811	17840	17869
151	17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
152	18148	18213	18241	18270	18298	18327	18355	18384	18412	18441
153	18469	18497	18526	18854	18583	18611	18639	18667	18696	18724
154	18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
155	19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
156	19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
157	19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
158	19866	19893	19921	19948	19975	20003	20030	20058	20085	20112
159	20140	20167	20194	20222	20249	20276	20303	20330	20358	20385

No.	0	1	2	3	4	5	6	7	8	9
160	20412	20439	20466	20493	20520	20547	20575	20602	20629	20656
161	20683	20710	20736	20763	20790	20817	20844	20871	20898	20925
162	20951	20978	21005	21032	21059	21085	21112	21139	21165	21192
163	21219	21245	21272	21299	21325	21352	21378	21405	21431	21458
164	21484	21511	21537	21564	21590	21617	21643	21669	21696	21722
165	21748	21775	21801	21827	21854	21880	21906	21932	21958	21985
166	22011	22037	22063	22089	22115	22141	22167	22194	22220	22246
167	22272	22298	22324	22350	22375	22401	22427	22453	22479	22505
168	22531	22557	22583	22608	22634	22660	22686	22711	22737	22763
169	22789	22814	22840	22866	22891	22917	22943	22968	22994	23019
170	23045	23070	23096	23121	23147	23172	23198	23223	23249	23274
171	23300	23325	23350	23376	23401	23426	23452	23477	23502	23528
172	23553	23578	23603	23628	23654	23679	23704	23729	23754	23779
173	23805	23830	23855	23880	23905	23930	23955	23980	24005	24030
174	24055	24080	24105	24130	24155	24179	24204	24229	24254	24279
175	24304	24329	24353	24378	24403	24428	24452	24477	24502	24527
176	24551	24576	24601	24625	24650	24674	24699	24724	24748	24773
177	24797	24822	24846	24871	24895	24920	24944	24969	24993	25018
178	25042	25066	25091	25115	25139	25164	25188	25212	25237	25261
179	25285	25310	25334	25358	25382	25406	25431	25455	25479	25503
180	25527	25551	25575	25600	25624	25648	25672	25696	25720	25744
181	25768	25792	25816	25840	25864	25888	25912	25935	25959	25983
182	26007	26031	26055	26079	26102	26126	26150	26174	26198	26221
183	26245	26269	26292	26316	26340	26364	26387	26411	26435	26458
184	26482	26505	26529	26552	26576	26600	26623	26647	26670	26694
185	26717	26741	26764	26787	26811	26834	26858	26881	26905	26928
186	26951	26975	26998	27021	27045	27068	27091	27114	27138	27161
187	27184	27207	27231	27254	27277	27300	27323	27346	27370	27393
188	27416	27439	27462	27485	27508	27531	27554	27577	27600	27623
189	27646	27669	27692	27715	27738	27761	27784	27807	27830	27852
190	27875	27898	27921	27944	27967	27989	28012	28035	28058	28081
191	28103	28126	28149	28171	28194	28217	28240	28262	28285	28307
192	28330	28353	28375	28398	28420	28443	28466	28488	28511	28533
193	28556	28578	28601	28623	28646	28668	28690	28713	28735	28758
194	28780	28803	28825	28847	28870	28892	28914	28937	28959	28981
195	29003	29026	29048	29070	29092	29115	29137	29159	29181	29203
196	29226	29248	29270	29292	29314	29336	29358	29380	29402	29425
197	29447	29469	29491	29513	29535	29557	29579	29601	29623	29645
198	29666	29688	29710	29732	29754	29776	29798	29820	29842	29863
199	29885	29907	29929	29951	29972	29994	30016	30338	30059	30081
200	30103	30125	30146	30168	30190	30211	30233	30255	30276	30298
201	30320	30341	30363	30384	30406	30427	30449	30471	30492	30514
202	30535	30557	30578	30600	30621	30642	30664	30685	30707	30728
203	30750	30771	30792	30814	30835	30856	30878	30899	30920	30942
204	30963	30984	31006	31027	31048	31069	31091	31112	31133	31154
205	31175	31197	31218	31239	31260	31281	31302	31323	31344	31366
206	31387	31408	31429	31450	31471	31492	31513	31534	31555	31576
207	31597	31618	31639	31660	31681	31702	31723	31744	31765	31785
208	31806	31827	31848	31869	31890	31911	31931	31952	31973	31994
209	32015	32035	32056	32077	32098	32118	32139	32160	32180	32201
210	32222	32243	32263	32284	32305	32325	32346	32367	32387	32408
211	32428	32449	32469	32490	32510	32531	32552	32572	32593	32613
212	32634	32654	32674	32695	32715	32736	32756	32777	32797	32818
213	32838	32858	32879	32899	32919	32940	32960	32980	33001	33021
214	33041	33062	33082	33102	33122	33143	33163	33183	33203	33224
215	33244	33264	33284	33304	33325	33345	33365	33385	33405	33425
216	33445	33465	33486	33506	33526	33546	33566	33586	33606	33626
217	33646	33666	33686	33706	33726	33746	33766	33786	33806	33826
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222	34635	34655	34674	34694	34713	34733	34752	34772	34791	34811
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232	36549	36567	36586	36605	36624	36642	36661	36680	36698	36717
233	36736	36754	36773	36791	36810	36829	36847	36866	36884	36903
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236	37291	37310	37328	37346	37365	37383	37401	37420	37438	37456
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241	38202	38220	38238	38256	38274	38292	38310	38328	38346	38364
242	38381	38399	38417	38435	38453	38471	38489	38507	38525	38543
243	38561	38578	38596	38614	38632	38650	38668	38685	38703	38721
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247	39270	39287	39305	39322	39340	39357	39375	39393	39410	39428
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266	42488	42504	42521	42537	42553	42570	42586	42602	42619	42635
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269	42975	42991	43007	43024	43040	43056	43072	43088	43104	43120
270	43136	43152	43168	43185	43201	43217	43233	43249	43265	43281
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278	44404	44420	44436	44451	44467	44482	44498	44514	44529	44545
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282	45025	45040	45056	45071	45086	45102	45117	45133	45148	45163
283	45179	45194	45209	45225	45240	45255	45271	45286	45301	45316
284	45332	45347	45362	45378	45393	45408	45423	45439	45454	45469
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289	46090	46105	46120	46135	46150	46165	46180	46195	46210	46225
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296	47129	47144	47158	47173	47188	47202	47217	47232	47246	47261
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305	48430	48444	48458	48473	48487	48501	48515	48529	48544	48558
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307	48714	48728	48742	48756	48770	48784	48799	48813	48827	48841
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357	55267	55279	55291	55303	55315	55328	55340	55352	55364	55376
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360	55630	55642	55654	55666	55678	55690	55703	55715	55727	55739
361	55751	55763	55775	55787	55799	55811	55823	55835	55847	55859
362	55871	55883	55895	55907	55919	55931	55943	55955	55967	55979
363	55991	56003	56015	56026	56039	56050	56062	56074	56086	56098
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366	56348	56360	56372	56384	56395	56407	56419	56431	56443	56455
367	56467	56478	56490	56502	56514	56526	56538	56549	56561	56573
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373	57171	57182	57194	57206	57217	57229	57241	57252	57264	57275
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392	59329	59340	59351	59362	59373	59384	59395	59406	59417	59428
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409	61172	61183	61194	61204	61215	61225	61236	61247	61257	61268
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687	83696	83702	83708	83715	83721	83727	83734	83740	83746	83753
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886	94743	94748	94753	94758	94763	94768	94773	94778	94783	94787
887	94792	94797	94802	94807	94812	94817	94822	94827	94832	94836
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898	95328	95332	95337	95342	95347	95352	95357	95361	95366	95371
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901	95472	95477	95482	95487	95492	95497	95501	95506	95511	95516
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903	95569	95574	95578	95583	95588	95593	95598	95602	95607	95612
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905	95665	95670	95674	95679	95684	95689	95694	95698	95703	95708
906	95713	95718	95722	95727	95732	95737	95742	95746	95751	95756
907	95761	95766	95770	95775	95780	95785	95789	95794	95799	95804
908	95809	95813	95818	95823	95828	95832	95837	95842	95847	95852
909	95856	95861	95866	95871	95875	95880	95885	95890	95895	95899
910	95904	95909	95914	95918	95923	95928	95933	95938	95942	95947
911	95952	95957	95961	95966	95971	95976	95980	95985	95990	95995
912	95999	96004	96009	96014	96019	96023	96028	96033	96038	96042
913	96047	96052	96057	96061	96066	96071	96076	96080	96085	96090
914	96095	96099	96104	96109	96114	96118	96123	96128	96133	96137
915	96142	96147	96152	96156	96161	96166	96171	96175	96180	96185
916	96190	96194	96199	96204	96209	96213	96218	96223	96227	96232
917	96237	96242	96246	96251	96256	96261	96265	96270	96275	96280
918	96284	96289	96294	96298	96303	96308	96313	96317	96322	96327
919	96332	96336	96341	96346	96350	96355	96360	96365	96369	96374
920	96379	96384	96388	96393	96398	96402	96407	96412	96417	96421
921	96426	96431	96435	96440	96445	96450	96454	96459	96464	96468
922	96473	96478	96483	96487	96492	96497	96501	96500	96511	96515
923	96520	96525	96530	96534	96539	96544	96548	96553	96558	96562
924	96567	96572	96577	96581	96586	96591	96595	96600	96605	96609
925	96614	96619	96624	96628	96633	96638	96642	96647	96652	96656
926	96661	96666	96670	96675	96680	96685	96689	96694	96699	96703
927	96708	96713	96717	96722	96727	96731	96736	96741	96745	96750
928	96755	96759	96764	96769	96774	96778	96783	96788	96792	96797
929	96802	96806	96811	96816	96820	96825	96830	96834	96839	96844
930	96848	96853	96858	96862	96867	96872	96876	96881	96886	96890
931	96895	96900	96904	96909	96914	96918	96923	96928	96932	96937
932	96942	96946	96951	96956	96960	96965	96970	96974	96979	96984
933	96988	96993	96997	97002	97007	97011	97016	97021	97025	97030
934	97035	97039	97044	97049	97053	97058	97063	97067	97072	97077
935	97081	97086	97090	97095	97100	97104	97109	97114	97118	97123
936	97128	97132	97137	97142	97146	97151	97155	97160	97165	97169
937	97174	97179	97183	97188	97192	97197	97202	97206	97211	97216
938	97220	97225	97230	97234	97239	97243	97248	97253	97257	97262
939	97267	97271	97276	97280	97285	97290	97294	97299	97304	97308

No.	0	1	2	3	4	5	6	7	8	9
940	97313	97317	97322	97327	97331	97336	97340	97345	97350	97354
941	97359	97364	97368	97373	97377	97382	97387	97391	97396	97400
942	97405	97410	97414	97419	97424	97428	97433	97437	97442	97447
943	97451	97456	87460	97465	97470	97474	97479	97483	97488	97493
944	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
945	97543	97548	97552	97557	97562	97566	97571	97575	97580	97585
946	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
947	97635	97640	97644	97649	97653	97658	94663	97667	97672	97676
948	97681	97685	97690	97695	97699	97704	97708	97713	97717	97722
949	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	97772	97777	97782	97786	97791	97795	97800	97804	97809	97813
951	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
952	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
953	97909	97914	97918	97923	97928	97932	97937	97941	97946	97950
954	97955	97959	97964	97968	97973	97978	97982	97987	97991	97996
955	98000	98005	98009	98014	98019	98023	98028	98032	98037	98041
956	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
957	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
958	98137	98141	98146	98150	98155	98159	98164	98168	98173	98177
959	98182	98186	98191	98195	98200	98204	98209	98214	98218	98223
960	98227	98232	98236	98241	98245	98250	98254	98259	98263	98268
961	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
962	98318	98322	98327	98331	98336	98340	98345	98349	98354	98358
963	98363	98367	98372	98376	98381	98385	98390	98394	98399	98403
964	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
965	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
966	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
967	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
968	98588	98592	98597	8601	98605	98610	98614	98619	98623	98628
969	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	98677	98682	98686	98691	98695	98700	98704	98709	98713	98717
971	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
972	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
973	98811	98816	98820	98825	98829	98834	98838	98843	98847	98851
974	98856	98860	98865	98869	98874	98878	98883	98887	98892	98896
975	98900	98905	98909	98914	98918	98923	98927	98932	98936	98941
976	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
977	98989	98994	98998	99003	99007	99012	99016	99021	99025	99029
978	99034	99038	99043	99047	99052	99056	99061	99065	99069	99074
979	99078	99083	99087	99092	99096	99100	99105	99109	99114	99118
980	99123	99127	99131	99136	99140	99145	99149	99154	99158	99162
981	99167	99171	99176	99180	99185	99189	99193	99198	99202	99207
982	99211	99216	99220	99224	99229	99233	99238	99242	99247	99251
983	99255	99260	99264	99269	99273	99277	99282	99286	99291	99295
984	99300	99304	99308	99313	99317	99322	99326	99330	99335	99339
985	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
986	99388	99392	99396	99401	99405	99410	99414	99419	99423	99427
987	99432	99436	99441	99445	99449	99454	99458	99463	99467	99471
988	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
989	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	99564	99568	99572	99577	99581	99585	99590	99594	99599	99603
991	99607	99612	99616	99621	99625	99629	99634	99638	99642	99647
992	99651	99656	99660	99664	99669	99673	99677	99682	99686	99691
993	99695	99699	99704	99708	99712	99717	99721	99726	99730	99734
994	99739	99743	99747	99752	99756	99760	99765	99769	99774	99778
995	99782	99787	99791	99795	99800	99804	99808	99813	99817	99822
996	99826	99830	99835	99839	99843	99848	99852	99856	99861	99865
997	99870	99874	99878	99883	99887	99891	99896	99900	99904	99909
998	99913	99917	99922	99926	99930	99935	99939	9994	99948	99952
999	99957	99961	99965	99970	99974	99978	99983	99987	99991	99996

M.	Sine	Co-ſine.	Tangent.	Co tang.	Secant.	Co-ſecant	
0	10.00000	10.00000	0.000000	Infinite.	10.00000	Infinite.	60
1	6.46373	10.00000	6.46373	13.53627	10.00000	13.53627	59
2	76476	00000	76476	23524	00000	23524	58
3	94085	00000	94085	05915	00000	05915	57
4	7.06579	00000	7.06579	12.93421	00000	12.93421	56
5	16270	00000	16270	83730	00000	83730	55
6	24188	00000	24188	75812	00000	75812	54
7	30882	00000	30882	69118	00000	69118	53
8	36681	00000	36682	63318	00000	63318	52
9	41797	00000	41797	58203	00000	58203	51
10	46373	00000	46373	53627	00000	53627	50
11	7.40512	10.00000	7.50512	12.49488	10.00000	12.49488	49
12	54291	00000	54291	45709	00000	45709	48
13	57767	00000	57767	42233	00000	42233	47
14	60985	00000	60986	39014	00000	39015	46
15	63982	00000	63982	36018	00000	36018	45
16	66784	00000	66785	33215	00000	33216	44
17	69417	9.99999	69418	30582	00000	30583	43
18	71900	99999	71900	28100	00001	28100	42
19	74248	99999	74248	25752	00001	25752	41
20	76475	99999	76476	23524	00001	23525	40
21	7.78594	9.99999	7.78595	12.21405	10.00001	12.21406	39
22	80615	99999	80615	19385	00001	19385	38
23	82545	99999	82546	17454	00001	17455	37
24	84393	99999	84394	15606	00001	15607	36
25	86166	99999	86167	13833	00001	13834	35
26	87870	99999	87871	12130	00001	12130	34
27	89509	99999	89510	10490	00001	10491	33
28	92088	99999	91089	08911	00001	08912	32
29	92612	99999	92613	07387	00002	07388	31
30	94084	99999	94086	05914	00002	05915	30
31	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	96887	99998	96889	03111	00002	03113	28
33	98223	99998	98225	01775	00002	01777	27
34	99520	99998	99522	00478	00002	00480	26
35	8.00779	99998	8.00781	11.99219	00002	11.99221	25
36	02002	99998	02004	97996	00002	97998	24
37	03192	99997	03194	96805	00002	96808	23
38	04350	99997	04353	95647	00003	95650	22
39	05478	99997	05481	94519	00003	94522	21
40	06578	99997	06581	93419	00003	93422	20
41	8.07650	9.99997	8.07653	11.92347	10.00003	11.92350	19
42	08696	99997	08700	91300	00003	91304	18
43	09718	99997	09722	90278	00003	90281	17
44	10717	99996	10720	89280	00004	89283	16
45	11693	99996	11696	88304	00004	88307	15
46	12647	99196	12651	87349	00004	87356	14
47	13581	99996	13585	86415	00004	86419	13
48	14495	99996	14500	85500	00004	85505	12
49	15391	99996	15395	84605	00005	84609	11
50	16268	99995	16273	83727	00005	83732	10
51	8.17128	9.99995	8.17132	11.82867	10.00005	11.82872	9
52	17971	99995	17976	82024	00005	82029	8
53	18798	99995	18804	81196	00005	81202	7
54	19610	99995	19616	80384	00005	80390	6
55	20407	99994	20413	79587	00006	79593	5
56	21189	99994	21195	78805	00006	78811	4
57	21958	99994	21964	78036	00006	78042	3
58	22713	99994	22719	77280	00006	77206	2
59	23456	99994	23462	76538	00006	76544	1
60	24186	99993	24192	75808	00006	75814	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecan	Secant.	M.

89 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	8.24185	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75090	00007	75097	59
2	25609	99993	25616	74384	00007	74391	58
3	26304	99993	26311	73688	00007	73696	57
4	26988	99992	26996	73004	00007	73012	56
5	27661	99992	27669	72331	00008	72339	55
6	28324	99992	28332	71668	00008	71676	54
7	28977	99992	28985	71014	00008	71023	53
8	29621	99991	29629	70371	00008	70379	52
9	30255	99981	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99991	31505	68495	00009	68505	49
12	32103	99990	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00010	67298	47
14	33292	99990	33302	66697	00010	66708	46
15	33875	99989	33886	66114	00010	66125	45
16	34450	99989	34461	65539	00011	65550	44
17	35018	99989	35029	64971	00011	64982	43
18	35578	99989	35589	64410	00011	64422	42
19	36131	99989	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63310	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60690	35
26	39818	99986	39832	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43231	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46366	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46798	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99980	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50131	49870	00022	49892	11
50	8.50504	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99976	51696	48304	00023	48328	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99973	54308	45692	00026	45718	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

88 Degrees.

M.	Sine.	Co-ſine	Tangent.	Co-tang.	Tangent.	Co-ſecant	
0	8.54282	9.99973	8.54309	11.45692	10.00026	11.45718	60
1	54642	99973	54669	45331	00027	45358	59
2	54999	99973	55027	44973	00027	45000	58
3	55354	99972	55382	44618	00028	44646	57
4	55705	99972	55734	44266	00028	44295	56
5	56054	99971	56083	43917	00029	43946	55
6	56400	99971	56429	43572	00029	43600	54
7	56743	99970	56773	43227	00030	43257	53
8	57084	99970	57114	42886	00030	42916	52
9	57421	99970	57452	42548	00030	42579	51
10	8.57757	9.99969	8.57788	11.42212	10.00031	11.42243	50
11	58089	99968	58121	41879	00031	41911	49
12	58419	99968	58451	41549	00032	41581	48
13	58747	99967	58779	41221	00032	41253	47
14	59072	99967	59105	40895	00033	40927	46
15	59395	99966	59428	40572	00033	40605	45
16	59715	99966	59749	40251	00034	40285	44
17	60033	99965	60068	39932	00034	39967	43
18	60349	99965	60384	39616	00035	39651	42
19	60662	99964	60698	39302	00035	39338	41
20	8.60973	9.99964	8.61009	11.38991	10.00036	11.39027	40
21	61282	99963	61319	38681	00036	38718	39
22	61589	99963	61626	38374	00037	38411	38
23	61894	99962	61931	38069	00038	38106	37
24	62196	99962	62234	37766	00038	37804	36
25	62496	99961	62535	37465	00039	37503	35
26	62795	99961	62834	37166	00039	37205	34
27	63091	99960	63131	36869	00040	36909	33
28	63385	99960	63426	36574	00040	36615	32
29	63678	99959	63718	36281	00041	36322	31
30	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
31	64256	99958	64298	35702	00042	35744	29
32	64543	99957	64585	35415	00042	35457	28
33	64827	99957	64870	35130	00043	35173	27
34	65110	99956	65154	34846	00044	34890	26
35	65391	99956	65435	34565	00044	34609	25
36	65670	99955	65715	34285	00045	34330	24
37	65947	99955	65993	34007	00045	34052	23
38	66223	99954	66269	33731	00046	33777	22
39	66497	99953	66543	33457	00046	33503	21
40	8.66769	9.99953	8.66816	11.33184	10.00047	11.33231	20
41	67039	99952	67087	32913	00048	32961	19
42	67308	99952	67356	32644	00048	32692	18
43	67575	99951	67624	32376	00049	32425	17
44	67840	99951	67890	32110	00049	32160	16
45	68104	99950	68154	31846	00950	31896	15
46	68366	99949	68417	31583	00051	31633	14
47	68627	99949	68678	31322	00051	31373	13
48	68886	99948	68938	31062	00052	31114	12
49	69144	99947	69196	30804	00052	30856	11
50	8.69400	9.99947	8.69453	11.30547	10.00053	11.30600	10
51	69654	99946	69708	30292	00054	30346	9
52	69907	99946	69962	30038	00054	30093	8
53	70159	99945	70214	29786	00055	29841	7
54	70409	99944	70465	29535	00056	29591	6
55	70658	99944	70714	29286	00056	29342	5
56	70905	99943	70962	29038	00057	29095	4
57	71151	99942	71208	28792	00058	28849	3
58	71395	99942	71453	28546	00058	28605	2
59	71638	99941	71697	28303	00059	28361	1
60	71880	99940	71940	28060	00059	28120	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	8.71880	9.99940	8.71940	11.28060	10.00059	11.28120	60
1	72120	99940	72181	27819	00060	27880	59
2	72359	99939	72420	27580	00061	27640	58
3	72597	99938	72659	27341	00062	27403	57
4	72834	99938	72896	27104	00062	27166	56
5	73069	99937	73132	26868	00063	26930	55
6	73303	99936	73366	26634	00064	26697	54
7	73535	99936	73600	26400	00064	26465	53
8	73767	99935	73832	26168	00065	26233	52
9	73997	99934	74063	25937	00065	26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	10.25774	50
11	74454	99933	74521	25479	00067	25546	49
12	74680	99932	74748	25252	00068	25320	48
13	74905	99931	74974	25026	00068	25093	47
14	75130	99931	75199	24801	00069	24870	46
15	75353	99930	75423	24577	00070	24647	45
16	75575	99929	75645	24355	00070	24425	44
17	75795	99929	75867	24133	00071	24204	43
18	76015	99928	76087	23913	00072	23985	42
19	76234	99927	76306	23693	00073	23766	41
20	8.76451	9.99926	8.76525	11.23475	10.00073	11.23549	40
21	76667	99926	76742	23258	00074	23332	39
22	76883	99925	76958	23042	00075	23117	38
23	77097	99924	77173	22827	00076	22903	37
24	77310	99923	77387	22613	00076	22690	36
25	77522	99923	77599	22400	00077	22478	35
26	77733	99922	77811	22189	00078	22267	34
27	77943	99921	78022	21978	00079	22057	33
28	78152	99920	78232	21768	00079	21848	32
29	78360	99920	78441	21559	00080	21639	31
30	8.78567	9.99919	8.78649	11.21351	10.00081	I. 21432	30
31	78774	99918	78855	21145	00082	21226	29
32	78979	99617	79061	20939	00083	21021	28
33	79183	99917	79266	20734	00083	20817	27
34	79386	99916	79470	20530	00084	20614	26
35	79588	99915	79673	20327	00085	20412	25
36	79789	99914	79875	20124	00086	20211	24
37	79990	99913	80076	19924	00087	20010	23
38	80189	99913	80276	19723	00087	19811	22
39	80388	99912	80476	19523	00088	19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	80782	99910	80872	19128	00090	19218	19
42	80978	99909	81068	18932	00091	19022	18
43	81173	99909	81264	18736	00091	18827	17
44	81367	99908	81459	18541	00092	18633	16
45	81560	99907	81653	18347	00093	18440	15
46	81752	99906	81846	18154	00094	18248	14
47	81944	99905	82038	17962	00095	18056	13
48	82134	99904	82230	17770	00096	17866	12
49	82324	99904	82420	17579	00097	17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	82701	99902	82799	17201	00098	17299	9
52	82888	99901	82987	17013	00099	17112	8
53	83075	99900	83175	16825	00100	16925	7
54	83261	99899	83361	16639	00101	16739	6
55	83446	99898	83547	16453	00102	16554	5
56	83630	99898	83732	16268	00102	16370	4
57	83813	99897	83916	16084	00103	16187	3
58	83996	99896	84100	15900	00104	16004	2
59	84177	99895	84282	15717	00105	15823	1
60	84358	99894	84464	15536	00106	15642	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

86 Degrees.

M.	Sine.	Co-ſine.	Tangent	Co-tang.	Secant.	Co-ſecant	
0	8.84358	9.99894	8.84464	11.15536	10.00106	11.15642	60
1	84539	99893	84645	15355	00107	15461	59
2	84718	99892	84826	15175	00108	15282	58
3	84897	99891	85006	14995	00109	15103	57
4	85075	99890	85185	14814	00109	14925	56
5	85252	99890	85363	14637	00110	14748	55
6	85429	99889	85540	14460	00111	14571	54
7	85605	99888	85717	14283	00112	14395	53
8	85780	99887	85893	14107	00113	14220	52
9	85955	99886	86069	13931	00114	14045	51
10	8.86128	9.99885	8.86243	11.13757	10.00115	11.13872	50
11	86301	99884	86417	13583	00116	13699	49
12	86474	99883	86590	13409	00117	13526	48
13	86645	99882	86763	13237	00118	13355	47
14	86816	99881	86935	13065	00119	13183	46
15	86987	99880	87106	12894	00120	13013	45
16	87156	99879	87277	12723	00120	12843	44
17	87325	99878	87447	12553	00121	12674	43
18	87494	99878	87617	12384	00122	12506	42
19	87661	99877	87785	12215	00123	12338	41
20	8.87829	9.99876	8.87953	11.12047	10.00124	11.12171	40
21	87995	99875	88120	11880	00125	12005	39
22	88161	99874	88287	11713	00126	11839	38
23	88326	99873	88453	11547	00127	11674	37
24	88490	99872	88618	11381	00128	11510	36
25	88654	99871	88783	11217	00129	11346	35
26	88817	99870	88948	10052	00130	11183	34
27	88980	99869	89111	10889	00131	11020	33
28	89142	99868	89274	10726	00132	10858	32
29	89304	99867	89437	10563	00133	10696	31
30	8.89464	9.99866	8.89598	11.10402	10.00134	11.10536	30
31	89624	99865	89760	10240	00135	10375	29
32	89784	99864	89920	10080	00136	10216	28
33	89943	99863	90080	09920	00137	10057	27
34	90102	99862	90240	09760	00138	09898	26
35	90260	99861	90399	09601	00139	09740	25
36	90417	99860	90557	09443	00140	09583	24
37	90574	99859	90715	09285	00141	09426	23
38	90730	99858	90872	09128	00142	09270	22
39	90885	99857	91028	08971	00143	09115	21
40	9.91040	9.99856	8.91185	11.08815	10.00144	1 108960	20
41	91195	99855	91340	08660	00145	08805	19
42	91349	99854	91495	08505	00146	08651	18
43	91502	99853	91649	08350	00147	08498	17
44	91655	99852	91803	08197	00148	08345	16
45	91807	99851	91957	08043	00149	08193	15
46	91959	99849	92110	07890	00150	08041	14
47	92110	99848	92262	07738	00151	07890	13
48	92261	99847	92414	07586	00153	07739	12
49	92411	99846	92565	07435	00154	07589	11
50	8.92561	9.99845	8.92716	11.07284	10.00155	11.07439	10
51	92710	99844	92866	07134	00156	07290	9
52	92859	99843	93015	06984	00157	07141	8
53	93007	99842	93165	06835	00158	06993	7
54	93154	99841	93313	06687	00159	06846	6
55	93301	99840	93462	06538	00160	06698	5
56	93448	99839	63609	06391	00161	06552	4
57	93594	99838	93756	06243	00162	06406	3
58	93740	99837	93903	06097	00163	06260	2
59	93885	99835	94049	05951	00164	06115	1
60	94030	99834	94195	05805	00166	05970	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

85 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05970	60
1	94174	99833	94340	05660	00167	05826	59
2	94317	99832	94485	05515	00168	05683	58
3	94461	99831	94629	05370	00169	05539	57
4	94603	99830	94773	05227	00170	05397	56
5	94746	99829	94917	05083	00171	05254	55
6	94887	99828	95060	04940	00172	05113	54
7	95029	99827	95202	04798	00173	04971	53
8	95170	99825	95344	04656	00174	04830	52
9	95310	99824	95486	04514	00175	04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	95590	99822	95767	04233	00178	04411	49
12	95728	99821	95907	04092	00179	04272	48
13	95867	99820	96047	03953	00180	04133	47
14	96005	99819	96187	03813	00181	03995	46
15	96143	99817	96325	03675	00183	03857	45
16	96280	99816	96464	03536	00184	03720	44
17	96417	99815	96602	03398	00185	03583	43
18	96553	99814	96739	03261	00186	03447	42
19	96689	99813	96877	03123	00187	03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	96960	99810	97150	02850	00190	03040	39
22	97095	99809	97285	02714	00191	02905	38
23	97229	99808	97421	02579	00192	02771	37
24	97363	99807	97556	02444	00193	02637	36
25	97496	99806	97691	02309	00194	02504	35
26	97629	99804	97825	02175	00196	02371	34
27	97762	99803	97959	02041	00197	02238	33
28	97894	99802	98092	01908	00198	02106	32
29	98026	99801	98225	01775	00199	01974	31
30	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	98288	99798	98490	01510	00202	01712	29
32	98419	99797	98622	01378	00203	01581	28
33	98549	99796	98753	01247	00204	01450	27
34	98679	99795	98884	01116	00205	01321	26
35	98808	99793	99015	00985	00206	01192	25
36	98937	99792	99145	00855	00208	01063	24
37	99066	99791	99275	00725	00209	00934	23
38	99194	99790	99405	00595	00210	00806	22
39	99322	99788	99534	00466	00211	00678	21
40	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	99577	99786	99791	00209	00214	00423	19
42	99704	99785	99919	00081	00215	00296	18
43	99830	99783	9.00046	10.99954	00216	00170	17
44	99956	99782	00174	99826	00218	00044	16
45	9.00082	99781	00301	99699	00219	10.99918	15
46	00207	99780	00427	99573	00220	99793	14
47	00332	99779	00553	99447	00222	99668	13
48	00456	99777	00679	99321	00223	99544	12
49	00580	99776	00805	99195	00224	99419	11
50	9.00704	9.99774	9.00930	10.99070	10.00225	10.99296	10
51	00828	99773	01055	98945	00227	99172	9
52	00951	99772	01179	98821	00228	99049	8
53	01074	99771	01303	98697	00229	98926	7
54	01196	99769	01427	98573	00231	98884	6
55	01318	99768	01550	98450	00232	98682	5
56	01440	99767	01673	98327	00233	98560	4
57	01561	99765	01796	98204	00234	98439	3
58	01681	99764	01918	98082	00236	98318	2
59	01803	99763	02040	97960	00237	98197	1
60	01923	99761	02162	97838	00239	98077	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

84 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.01923	9.99761	9.02162	10.97838	10.00239	10.98076	60
1	02043	99760	02283	97717	00240	97956	59
2	02163	99759	02404	97596	00241	97837	58
3	02283	99757	02525	97475	00243	97717	57
4	02402	99756	02645	97354	00244	97598	56
5	02520	99755	02765	97234	00245	97480	55
6	02639	99753	02885	97115	00247	97361	54
7	02757	99752	03005	96995	00248	97243	53
8	02874	99751	03124	96876	00249	97126	52
9	02992	99749	03242	96757	00251	97008	51
10	9.03109	9 99748	9.03361	10.96639	10.00252	10.96891	50
11	03226	99747	03479	96521	00253	96774	49
12	03342	99745	03597	96403	00255	96658	48
13	03458	99744	03714	96286	00256	96542	47
14	03574	99742	03832	96168	00257	96426	46
15	03690	99741	03948	96051	00259	96310	45
16	03805	99740	04065	95935	00260	96195	44
17	03920	99738	04181	95819	00262	96080	43
18	04034	99737	04297	95703	00263	95966	42
19	04149	99735	04413	95587	00264	95851	41
20	9.04262	9.99734	9.04528	10.95472	10.00266	10.95737	40
21	04376	99733	04643	95357	00267	95624	39
22	04489	99731	04758	95242	00269	95510	38
23	04603	99730	04873	95127	00270	95397	37
24	04715	99728	04987	95013	00271	95285	36
25	04828	99727	05101	94899	00273	95172	35
26	04940	99726	05214	94786	00274	95060	34
27	05052	99724	05328	94672	00276	94948	33
28	05164	99723	05441	94559	00277	94836	32
29	05275	99721	05553	94447	00279	94725	31
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	05497	99718	05778	94222	00281	94503	29
32	05607	99717	05890	94110	00283	94393	28
33	05717	99716	06002	93998	00284	94283	27
34	05827	99714	06113	93887	00286	94173	26
35	05937	99713	06224	93776	00287	94063	25
36	06046	99711	06335	93665	00289	93954	24
37	06155	99710	06445	93555	00290	93845	23
38	06264	99708	06556	93444	00292	93736	22
39	06372	99707	06665	93334	00293	93628	21
40	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	06588	99704	06885	93115	00296	93411	19
42	06696	99702	06994	93006	00298	93304	18
43	06804	99701	07103	92897	00299	93196	17
44	06911	99699	07211	92789	00301	93089	16
45	07018	99698	07320	92680	00302	92982	15
46	07124	99696	07428	92572	00304	92876	14
47	07231	99695	07536	92464	00305	92769	13
48	07337	99693	07643	92357	00307	92663	12
49	07442	99692	07750	92249	00308	92558	11
50	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	07653	99689	07964	92036	00311	92347	9
52	07758	99687	08071	91929	00313	92242	8
53	07863	99686	08177	91823	00314	92137	7
54	07968	99684	08283	91717	00316	92032	6
55	08072	99683	08389	91611	00317	91928	5
56	08176	99681	08495	91505	00319	91824	4
57	08280	99680	08601	91400	00320	91720	3
58	08383	99678	08705	91295	00322	91617	2
59	08486	99677	08810	91190	00323	91514	1
60	08589	99675	08914	91086	00325	91411	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

Artificial Sines, Tang. and Sec. 7 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	08692	99673	09019	90981	00326	91308	59
2	08795	99672	09123	90877	00328	91205	58
3	08897	99670	09227	90773	00330	91103	57
4	08999	99669	09330	90670	00331	91001	56
5	09101	99667	09434	90566	00333	90899	55
6	09202	99666	09537	90463	00334	90798	54
7	09304	99664	09640	90360	00336	90696	53
8	09405	99662	09742	90258	00337	90595	52
9	09506	99661	09845	90155	00339	90494	51
10	9.09606	9.99659	9.19947	10.90053	10.00341	10.90394	50
11	09706	99658	10049	89951	00342	90293	49
12	09807	99656	10150	89850	00344	90193	48
13	19906	99655	10252	89748	00345	90093	47
14	10006	99653	10353	89647	00347	89994	46
15	10106	99651	10454	89546	00349	89894	45
16	10205	99650	10555	89445	00350	89795	44
17	10304	99648	10656	89344	00352	89696	43
18	10402	99647	10756	89244	00353	89597	42
19	10501	99645	10856	89144	00355	89499	41
20	9.10599	9.99643	9.10956	10.89044	10.00357	10.89401	40
21	10697	99642	11056	88944	00358	89303	39
22	10795	99640	11155	88845	00360	89205	38
23	10893	99638	11254	88746	00362	89107	37
24	11990	99637	11353	88647	00363	89010	36
25	11087	99635	11452	88548	00365	88913	35
26	11184	99633	11551	88449	00366	88816	34
27	11281	99632	11649	88351	00368	88719	33
28	11377	99630	11747	88253	00370	88623	32
29	11474	99628	11845	88155	00371	88526	31
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	11666	99625	12040	87960	00375	88334	29
32	11761	99623	12138	87862	00376	88239	28
33	11857	99622	12235	87763	00378	88143	27
34	11952	99620	12332	87668	00380	88048	26
35	12047	99618	12428	87572	00381	87953	25
36	12142	99617	12525	87475	00383	87858	24
37	12236	99615	12621	87379	00385	87764	23
38	12331	99613	12717	87283	00387	87669	22
39	13425	99611	12813	87187	00388	87575	21
40	9.12519	9.99610	9.12909	10.87091	10.00390	10.87481	20
41	12612	99608	13004	86996	00392	87387	19
42	12706	99607	13099	86901	00393	87294	18
43	12799	99605	13194	86806	00395	87201	17
44	12892	99603	13289	86711	00397	87107	16
45	12985	99601	13384	86616	00398	87015	15
46	13078	99600	13478	86522	00400	86922	14
47	13171	99598	13573	86427	00402	86829	13
48	13263	99596	13667	86333	00404	86737	12
49	13355	99595	13760	86239	00405	86645	11
50	9.13447	9.99593	9.13854	10.86140	10.00407	10.86553	10
51	13539	99591	13948	86052	00409	86461	9
52	13630	99589	14041	85959	00411	86370	8
53	13722	99588	14134	85866	00412	86278	7
54	13813	99586	14227	85773	00414	86187	6
55	13904	99584	14320	85680	00416	86096	5
56	13994	99582	14412	85588	00418	86006	4
57	14085	99581	14504	85496	00419	85915	3
58	14175	99579	14596	85403	00421	85826	2
59	14266	99577	14688	85311	00423	85734	1
60	14356	99575	14780	85200	00425	85644	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

82 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.14356	9.99575	9.14780	10.85220	10.00425	10.85644	60
1	14445	99573	14872	85128	00426	85555	59
2	14535	99572	14963	85037	00428	85465	58
3	14624	99570	15054	84946	00430	85376	57
4	14714	99568	15145	84855	00432	85286	56
5	14803	99566	15236	84764	00434	85197	55
6	14891	99565	15327	84673	00435	85108	54
7	14980	99563	15417	84583	00437	85020	53
8	15069	99561	15508	84492	00439	84931	52
9	15157	99559	15598	84402	00441	84843	51
10	9.15245	9.99557	9.15688	10.84312	10.00443	10.84755	50
11	15333	99555	15777	84222	00444	84667	49
12	15421	99554	15867	84133	00446	84579	48
13	15508	99552	15956	84043	00448	84492	47
14	15596	99550	16046	83954	00450	84404	46
15	15683	99548	16135	83865	00452	84317	45
16	15770	99546	16224	83776	00454	84230	44
17	15857	99545	16312	83688	00455	84143	43
18	15943	99543	16401	83599	00457	84056	42
19	16030	99541	16489	83511	00459	83970	41
20	9.16116	9.99539	9.16577	10.83423	10.00461	10.83884	40
21	16203	99537	16665	83335	00463	83797	39
22	16289	99535	16753	83247	00465	83711	38
23	16374	99533	16841	83159	00467	83626	37
24	16460	99532	16928	83072	00468	83540	36
25	16545	99530	17016	82984	00470	83455	35
26	16631	99528	17103	82897	00472	83369	34
27	16716	99526	17190	82810	00474	83284	33
28	16801	99524	17277	82723	00476	83199	32
29	16886	99522	17363	82637	00478	83114	31
30	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
31	17055	99518	17536	82464	00482	82945	29
32	17139	99517	17622	82378	00483	82861	28
33	17223	99515	17708	82292	00485	82778	27
34	17307	99513	17794	82206	00487	82693	26
35	17391	99511	17880	82120	00489	82609	25
36	17474	99509	17965	82034	00491	82526	24
37	17558	99507	18051	81949	00493	82442	23
38	17641	99505	18136	81864	00495	82359	22
39	17724	99503	18221	81779	00497	82276	21
40	9.17807	9.99501	9.18306	10.81694	10.00499	10.82193	20
41	17890	99499	18391	81609	00501	82110	19
42	17973	99497	18475	81525	00503	82027	18
43	18055	99495	18560	81440	00504	81945	17
44	18137	99493	18644	81356	00506	81863	16
45	18220	99492	18728	81272	00508	81780	15
46	18302	99490	18812	81188	00510	81698	14
47	18383	99488	18896	81104	00512	81617	13
48	18465	99486	18979	81021	00514	81535	12
49	18547	99484	19063	80937	00516	81453	11
50	9.18628	9.99482	9.19146	10.80854	10.00518	10.81372	10
51	18709	99480	19229	80771	00520	81291	9
52	18790	99478	19312	80688	00522	81210	8
53	18871	99476	19395	80605	00524	81129	7
54	18952	99474	19478	80522	00526	81048	6
55	19033	99472	19561	80436	00528	80967	5
56	19113	99470	19643	80357	00530	80887	4
57	19193	99468	19725	80275	00532	80807	3
58	19273	99466	19807	80193	00534	80727	2
59	19353	99464	19889	80111	00536	80647	1
60	19433	99462	19971	80029	00538	80567	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

81 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	19513	99460	20053	79947	00540	80487	59
2	19592	99458	20134	79865	00542	80408	58
3	19672	99456	20216	79784	00544	80328	57
4	19751	99454	20297	79703	00546	80249	56
5	19830	99452	20378	79621	00548	80170	55
6	19909	99450	20459	79541	00550	80091	54
7	19988	99448	20540	79460	00552	80012	53
8	20067	99446	20621	79378	00554	79933	52
9	20145	99444	20701	79299	00556	79855	51
10	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	20302	99440	20862	79138	00500	79698	49
12	20380	99438	20942	79058	00562	79620	48
13	20458	99436	21022	78978	00564	79542	47
14	20535	99434	21102	78898	00566	79465	46
15	20613	99432	21181	78818	00568	79387	45
16	20691	99429	21261	78739	00570	79309	44
17	20768	99427	21340	78659	00573	79232	43
18	20845	99425	21420	78580	00575	79155	42
19	20922	99423	21499	78501	00577	79078	41
20	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21305	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21457	99409	22049	77951	00591	78542	34
27	21534	99407	22127	77873	00593	78465	33
28	21610	99404	22205	77795	00595	78390	32
29	21665	99402	22283	77717	00598	78315	31
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99388	22824	77177	00612	77788	24
37	22286	99385	22901	77099	00615	77714	23
38	22361	99384	22977	77022	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9.22509	9.99379	9.23130	10.76870	10.00621	10.77491	20
41	22583	99377	23202	76793	00623	77417	19
42	22657	99375	23283	76717	00625	77343	18
43	22731	99372	23355	76641	00628	77269	17
44	22805	99370	23435	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	23586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	23305	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76538	7
54	23535	99348	24186	75813	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76321	4
57	23751	99342	24410	75590	00658	76248	3
58	23823	99340	27484	75516	00660	76177	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24633	75368	00665	76033	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

80 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.23967	9.99335	9.24632	10.75368	10.00665	10.76033	60
1	24039	99333	24706	75294	00667	75961	59
2	24110	99331	24779	75221	00669	75890	58
3	24181	99328	24853	75147	00672	75819	57
4	24253	99326	24926	75074	00674	75747	56
5	24324	99324	25000	75000	00676	75676	55
6	24395	99322	25073	74927	00678	75605	54
7	24466	99319	25146	74854	00680	75534	53
8	24536	99317	25219	74781	00683	75464	52
9	24607	99315	25092	74708	00685	75393	51
10	9.24677	9.99313	9.25365	10.74635	10.00687	10.75323	50
11	24748	99310	25437	74563	00690	75252	49
12	24818	99308	25510	74490	00692	75182	48
13	24888	99306	25582	74418	00694	75112	47
14	24958	99304	25655	74345	00696	75042	46
15	25028	99301	25727	74273	00699	74972	45
16	25098	99299	25799	74201	00701	74902	44
17	25168	99297	25871	74129	00703	74832	43
18	25237	99294	25943	73057	00706	74762	42
19	25307	99292	26015	73985	00708	74693	41
20	9.25376	9.99290	9.26086	10.73914	10.00710	10,74623	40
21	25445	99288	26158	73842	00712	94555	39
22	25514	99285	26220	73771	00715	74486	38
23	25583	99283	26301	73699	00717	74417	37
24	25652	99281	26372	73628	00719	74348	36
25	25721	99278	26443	73557	00722	74279	35
26	25790	99276	26514	73486	00724	74210	34
27	25858	99274	26585	73415	00726	74142	33
28	25927	99271	26655	73344	00729	74073	32
29	25995	99269	26726	73274	00731	74005	31
30	9.26063	9.99267	9.26797	10.73203	10.00733	10.73937	30
31	26131	99264	26867	73133	00736	73869	29
32	26199	99262	26937	73063	00738	73801	28
33	26267	99260	27008	72992	00741	73733	27
34	26335	99257	27078	72922	00743	73665	26
35	26403	99255	27148	72852	00745	73597	25
36	26470	99252	27218	72782	00747	73530	24
37	26538	99250	27288	72712	00750	73462	23
38	26605	99248	27357	72643	00752	73395	22
39	26672	99245	27427	72573	00755	73328	21
40	9.26739	9.99243	9.27496	10.72504	10.00757	10.73261	20
41	26806	99241	27566	72434	00759	73193	19
42	26873	99238	27635	72365	00762	73127	18
43	26940	99236	27704	72296	00764	73060	17
44	27007	99233	27773	72227	00766	72993	16
45	27073	99231	27842	72158	00769	72927	15
46	27140	99229	27911	72089	00771	72860	14
47	27206	99226	27980	72020	00774	72794	13
48	27273	99224	28049	71951	00776	72727	12
49	27339	99221	28117	71883	00779	72661	11
50	9.27405	9.99219	9.28186	10.71814	10.00781	10.72595	10
51	27471	99217	28254	71746	00783	72529	9
52	27537	99214	28323	71677	00786	72463	8
53	27602	99212	28391	71609	00788	72398	7
54	27668	99209	28459	71541	00791	72332	6
55	27734	99207	28527	71473	00793	72266	5
56	27799	99204	28595	71405	00796	72201	4
57	27864	99202	28662	71338	00798	72136	3
58	27930	99200	28730	71270	00800	72070	2
59	27995	99197	28798	71202	00803	72005	1
60	28060	99195	28865	71135	00805	72940	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	28125	99192	28933	71067	00808	71875	59
2	28190	99190	29000	71000	00810	71810	58
3	28254	99187	29067	70933	00813	71746	57
4	28319	99185	29134	70866	00815	71681	56
5	28384	99182	29201	70799	00818	71616	55
6	28448	99180	29268	70732	00820	71552	54
7	28512	99177	29335	70665	00823	71488	53
8	28577	99175	29402	70598	00825	71423	52
9	28641	99172	29468	70532	00828	71359	51
10	9.28705	9.99170	8.29535	10.70465	10.00830	10.71295	50
11	28769	99167	29601	70399	00833	71231	49
12	28833	99165	29668	70332	00835	71167	48
13	28896	99162	29734	70266	00838	71104	47
14	28960	99160	29800	70200	00840	71040	46
15	29024	99157	29866	70134	00843	70975	45
16	29087	99155	29932	70068	00845	70913	44
17	29150	99152	29998	70002	00848	70850	43
18	29214	99150	30064	69936	00850	70786	42
19	29277	99147	30130	69870	00853	70723	41
20	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	29403	99142	30261	69739	00858	70597	39
22	29466	99140	30326	69674	00860	70534	38
23	29529	99137	30391	69609	00863	70471	37
24	29591	99135	30457	69543	00865	70409	36
25	29654	99132	30522	69478	00868	70346	35
26	29716	99130	30587	69413	00870	70284	34
27	29779	99127	30652	69348	00873	70221	33
28	29841	99124	30717	69283	00876	70159	32
29	29903	99122	30782	69218	00878	70097	31
30	9.29966	9.99119	9.30846	18.69154	10.00881	10.70034	30
31	30028	99117	30911	69089	00883	69972	29
32	30090	99114	30975	69025	00886	69910	28
33	30151	99112	31040	68960	00888	69849	27
34	30213	99109	31104	68896	00891	69787	26
35	30275	99106	31168	68831	00894	69725	25
36	30336	99104	31233	68767	00896	69664	24
37	30398	99101	31297	68703	00899	69602	23
38	30459	99099	31361	68639	00901	69541	22
39	30521	99096	31424	68575	00904	69479	21
40	9.30582	9.99093	9.31489	10.68511	10.00907	10.69418	20
41	30643	99091	31552	68448	00909	69357	19
42	30704	99088	31616	68384	00912	69296	18
43	30765	99086	31679	68320	00914	69235	17
44	30826	99083	31743	68257	00917	69174	16
45	30887	99080	31806	68194	00920	69115	15
46	30947	99078	31870	68130	00922	69059	14
47	31008	99075	31933	68067	00925	68992	13
48	31068	99072	31996	68004	00928	68931	12
49	31129	99070	31059	67941	00930	68871	11
50	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	31249	99064	32185	67815	00936	68750	9
52	31310	99062	32248	67752	00938	68690	8
53	31370	99059	32311	67689	00941	68630	7
54	31430	99056	32373	67627	00944	68570	6
55	31490	99054	32436	67564	00946	68510	5
56	31549	99051	32498	67502	00949	68451	4
57	31609	99048	32561	67439	00952	68391	3
58	31669	99046	32623	67377	00954	68331	2
59	31728	99043	32685	67315	00957	68272	1
60	31788	99040	32747	67252	00960	68212	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

78 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co ſecant	
0	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	60
1	31847	99038	32810	67190	00962	68153	59
2	31907	99035	32872	67128	00965	68093	58
3	31966	99032	32933	67067	00968	68034	57
4	32025	99030	32995	67005	00970	67975	56
5	32084	99027	33057	66943	00973	67916	55
6	32143	99024	33119	66881	00976	67857	54
7	32202	99022	33180	66820	00978	67798	53
8	32261	99019	33241	66758	00981	67739	52
9	32319	99016	33303	66697	00984	67681	51
10	9.32378	9.99013	9.33365	10.66635	19.00987	10.67622	50
11	32437	99011	33426	66574	00989	67563	49
12	32495	99008	33487	66513	00992	67505	48
13	32553	99005	33548	66452	00995	67447	47
14	32612	99002	33609	66391	00998	67388	46
15	32670	99000	33670	66330	01000	67330	45
16	32728	98997	33731	66269	01003	67272	44
17	32786	98994	32792	66208	01006	67214	43
18	32844	98991	33853	66147	01009	67156	42
19	32902	98989	33913	66087	01011	67098	41
20	9.32960	8.98986	9.33974	10.66026	10.01014	10.67040	40
21	33018	98983	34034	65966	01017	66982	39
22	33075	98980	34095	65905	01020	66925	38
23	33133	98978	34155	65845	01022	66867	37
24	33190	98975	34215	65784	01025	66810	36
25	33248	98972	34276	65724	01028	66752	35
26	33305	98969	34336	65664	01031	66695	34
27	33362	98967	34396	65604	01033	66638	33
28	33420	98964	34456	65544	01036	66580	32
29	33477	98961	34516	65484	01039	66523	31
30	9.33534	9.98958	9.34576	10.65424	10.01042	10.66466	30
31	33591	98955	34635	65365	01045	66409	29
32	33647	98953	34695	65305	01047	66352	28
33	33704	98950	34755	65245	01050	66296	27
34	33761	98947	34814	65186	01053	66239	26
35	33818	98944	34874	65126	01056	66182	25
36	33874	98941	34933	65067	01059	66126	24
37	33931	98938	34992	65008	01062	66069	23
38	33987	98936	35051	64949	01064	66013	22
39	34043	98933	35111	64889	01067	65957	21
40	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	34156	98927	35229	64771	01073	65844	19
42	34212	98924	35288	64712	01076	65788	18
43	34268	98921	35346	64653	01079	65732	17
44	34324	98919	35405	64595	01081	65676	16
45	34380	98916	35464	64536	01084	65620	15
46	34435	98913	35523	64478	01087	65564	14
47	34491	98910	35581	64419	01090	65509	13
48	34547	98907	35640	64360	01093	65453	12
49	34602	98904	35698	64302	01096	65398	11
50	9.34658	8.98901	9.35757	10.64243	10.01099	10.65342	10
51	34713	98898	35815	64185	01002	65287	9
52	34769	98896	35873	64127	01104	65231	8
53	34824	98893	35931	64069	01107	65176	7
54	34879	98890	35989	64011	01110	65121	6
55	34934	98887	36047	63953	01113	65066	5
56	34989	98884	36105	63895	01116	65011	4
57	35044	98881	36163	63837	01119	64956	3
58	35099	98878	36221	63779	01122	64901	2
59	35154	98875	36279	63721	01125	64846	1
60	35209	98872	36336	63664	01128	64791	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecan	Secant.	M.

77 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant.	
0	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	60
1	35263	98869	36394	63606	01130	64736	59
2	35318	98867	36451	63548	01133	64682	58
3	35373	98864	36509	63491	01136	64627	57
4	35427	98861	36566	63434	01139	64573	56
5	35481	98858	36624	63376	01142	64518	55
6	35536	98855	36681	63319	01145	64464	54
7	35590	98852	36738	63262	01148	64410	53
8	35644	98849	36795	63205	01151	64356	52
9	35698	98846	36852	63148	01154	64302	51
10	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	35806	98840	36966	63034	01160	64194	49
12	35860	98837	37023	62977	01163	64140	48
13	35914	98834	37080	62920	01166	64086	47
14	35968	98831	37137	62863	01169	64032	46
15	36021	98828	37193	62807	01172	63978	45
16	36075	98825	37250	62750	01175	63925	44
17	36129	98822	37306	62694	01178	63871	43
18	36182	98819	37363	62637	01181	63818	42
19	36236	98816	37419	62581	01184	63764	41
20	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	36342	98810	37532	62468	01190	63658	39
22	36395	98807	37588	62412	01193	63605	38
23	36448	98804	37644	62356	01196	63551	37
24	36502	98801	37700	62300	01199	63498	36
25	36555	98798	37756	62244	01202	63445	35
26	36607	98795	37812	62188	01205	63392	34
27	36660	98792	37869	62132	01208	63340	33
28	36713	98789	37924	62076	01211	63287	32
29	36766	98786	37980	62020	01214	63234	31
30	9.36818	9.98783	9.38035	10.61965	10.01217	10.63181	30
31	36871	98780	38091	61909	01220	63129	29
32	36924	98777	38147	61853	01223	63076	28
33	36976	98774	38202	61798	01226	63024	27
34	37028	98771	38257	61742	01229	62971	26
35	37081	98768	38313	61687	01232	62919	25
36	37133	98765	38368	61632	01235	62867	24
37	37185	98762	38423	61577	01238	62815	23
38	37237	98759	38479	61521	01241	62763	22
39	37289	98756	38534	61466	01244	62711	21
40	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	37393	98749	38644	61356	01250	62607	19
42	37445	98746	38699	61301	01254	62555	18
43	37497	98743	38754	61246	01257	62503	17
44	37549	98740	38808	61192	01260	62451	16
45	37600	98737	38863	61137	01263	62400	15
46	37652	98734	38918	61082	01266	62348	14
47	37703	98731	38972	61028	01269	62296	13
48	37755	98728	39027	60973	01272	62245	12
49	37806	98725	39081	60918	01275	62194	11
50	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	37909	98719	39190	60810	01281	62091	9
52	37960	98715	39245	60755	01285	62040	8
53	38011	98712	39299	60701	01288	61989	7
54	38062	98709	39353	60647	01291	61938	6
55	38113	98706	39407	60593	01294	61887	5
56	38164	98703	39461	60539	01297	61836	4
57	38215	98700	39515	60485	01300	61785	3
58	38266	98697	39569	60431	01303	61734	2
59	38317	98694	39623	60377	01306	61683	1
60	38368	98690	39677	60323	01310	61632	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

76 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.38368	9.98690	9.39677	10.60323	10.01310	10.61632	60
1	38418	98687	39731	60269	01313	61582	59
2	38469	98684	39785	60215	01316	61531	58
3	38519	98681	39838	60162	01319	61481	57
4	38570	98678	39892	60108	01322	61430	56
5	38620	98675	39945	60054	01325	61380	55
6	38670	98671	39999	60001	01329	61330	54
7	38721	98668	40052	59948	01332	61280	53
8	38771	98665	40106	59894	01335	61229	52
9	38821	98662	40159	59841	01338	61179	51
10	9.38871	9.98659	9.40212	10.59788	10.01341	10.61129	50
11	38921	98655	40266	59734	01344	61079	49
12	38971	98652	40319	59681	01348	61029	48
13	39021	98649	40373	59628	01351	60909	47
14	39071	98646	40425	59575	01354	60929	46
15	39121	93643	40478	59522	01357	60879	45
16	39170	98640	40531	59469	01360	60830	44
17	39220	98636	40584	59416	01364	60780	43
18	39270	98633	40636	59363	01367	60730	42
19	39319	98630	40689	59311	01371	60681	41
20	9.39369	9.98627	9.40742	10.59258	10.01373	10.60631	40
21	39418	98623	40795	59205	01377	60582	39
22	39467	98620	40847	59153	01380	60533	38
23	39517	98617	40900	59100	01383	60483	37
24	39566	98614	40952	59048	01386	60434	36
25	39615	98610	41004	58995	01390	60385	35
26	39664	98607	41057	58943	01393	60336	34
27	39713	98602	41109	58891	01396	60287	33
28	39762	98601	41161	58839	01399	60238	32
29	39811	98597	41214	58786	01403	60189	31
30	9.39860	9.98594	9.41266	10.58734	10.01406	10.60140	30
31	39909	98590	41318	58682	01409	60091	29
32	39957	98588	41370	58630	01412	60042	28
33	40006	98584	41422	58578	01416	59994	27
34	40055	98581	41474	58526	01419	59945	26
35	40103	98578	41526	58474	01422	59896	25
36	40152	98574	41577	58422	01426	59848	24
37	40200	96571	41629	58371	01429	59800	23
38	40249	98568	41681	58319	01432	59751	22
39	40297	98565	41733	58267	01435	59703	21
40	9.40345	9.98561	9.41784	10.58216	10.01439	10.59654	20
41	40394	98558	41836	58164	01442	59606	19
42	40442	98555	41887	58113	01445	59558	18
43	40490	98551	41939	58061	01449	59510	17
44	40538	98548	41990	58010	01452	59462	16
45	40586	98545	42041	57958	01455	59414	15
46	40634	98541	42093	57907	01459	59366	14
47	40682	98538	42144	57856	01462	59318	13
48	40730	98535	42195	57805	01465	59270	12
49	40778	98531	42246	57754	01469	59222	11
50	9.40825	9.98528	9.42297	10.57703	10.01472	10.59175	10
51	40873	98525	42348	57652	01475	59127	9
52	40921	98521	42399	57601	01479	59079	8
53	40968	98518	42450	57550	01482	59032	7
54	41016	98515	42501	57499	01485	58984	6
55	41063	98511	42552	57448	01489	58937	5
56	41111	98508	42603	57397	01492	58889	4
57	41158	98504	42653	57347	01495	58842	3
58	41205	98501	42704	57296	01499	58795	2
59	41252	98498	42755	57245	01502	58748	1
60	41300	98494	42805	57195	01506	58700	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

75 Degrees.

M.	Sine.	Co-ſine	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.41300	9.98494	9.42805	10.57195	10.01506	10.58700	60
1	41347	98495	42856	57144	01509	58653	59
2	41393	98488	42906	57094	01512	58606	58
3	41441	98484	42957	57043	01516	58559	57
4	41488	98481	43007	56993	01519	58512	56
5	41535	98477	43057	56943	01523	58465	55
6	41582	98474	43108	56892	01526	58418	54
7	41628	98471	43158	56842	01529	58372	53
8	41675	98467	43208	56792	01533	58325	52
9	41722	98464	43258	56742	01536	58278	51
10	9.41768	9.98460	9.43308	10.56692	19.01540	10.58232	50
11	41815	98457	43358	56642	01543	58185	49
12	41861	98453	43408	56592	01547	58138	48
13	41908	98450	43458	56542	01550	58092	47
14	41954	98447	43508	56492	01553	58046	46
15	42001	98443	43558	56442	01557	57999	45
16	42047	98440	43607	56393	01560	57933	44
17	42093	98436	43657	56343	01564	57907	43
18	42139	98433	43707	56293	01567	57860	42
19	42186	98429	43750	56244	01571	57814	41
20	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	42278	98422	43855	56145	01578	57722	39
22	42324	98419	43905	56095	01581	57676	38
23	42370	98415	43954	56046	01584	57630	37
24	42416	98412	44004	55996	01588	57584	36
25	42461	98409	44053	55947	01591	57538	35
26	42507	98405	44102	55898	01595	57493	34
27	42553	98402	44151	55848	01598	57447	33
28	42599	98398	44201	55799	01602	57401	32
29	42644	98395	44250	55750	01605	57356	31
30	9.42690	9.98391	9.44299	18.55701	10.01609	10.57310	30
31	42735	98388	44348	55652	01612	57265	29
32	42781	98384	44397	55603	01616	57219	28
33	42826	98381	44446	55554	01619	57174	27
34	42872	98377	44495	55505	01623	57128	26
35	42916	98373	44544	55456	01626	57083	25
36	42962	98370	44592	55408	01630	57038	24
37	43007	98366	44641	55359	01634	56993	23
38	43053	98363	44690	55310	01637	56947	22
39	43098	98359	44738	55262	01641	56902	21
40	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	43188	98352	44836	55164	01648	56812	19
42	43233	98349	44884	55116	01651	56767	18
43	43278	98345	44933	55067	01655	56722	17
44	43323	98342	44981	55019	01658	56677	16
45	43367	98337	45029	54971	01662	56632	15
46	43412	98334	45078	54922	01666	56588	14
47	43457	98331	45126	54874	01669	56543	13
48	43502	98327	45174	54826	01673	56498	12
49	43546	98324	45222	54778	01676	56454	11
50	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	43635	98317	45319	54681	01683	56365	9
52	43680	98313	45367	54633	01687	56320	8
53	43724	98309	45415	54585	01691	56276	7
54	43769	98306	45463	54537	01694	56231	6
55	43813	98302	45511	54489	01698	56187	5
56	43857	98299	45550	54441	01701	56143	4
57	43901	98295	45606	54394	01705	56099	3
58	43946	98291	45654	54346	01709	56054	2
59	43990	98288	45702	54298	01712	56010	1
60	44034	98284	45750	54250	01716	55966	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

74 Degrees.

16 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	44078	98281	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54108	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54013	01734	55746	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46092	53918	01741	55659	53
8	44385	98255	46180	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	44515	98244	46271	53728	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55397	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	44948	98207	46741	53259	01793	55051	39
22	44991	98203	46788	53212	01796	55008	38
23	45035	98200	46835	53165	01800	54965	37
24	45077	98196	46882	53119	01804	54923	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45292	98177	47114	52886	01823	54708	31
30	9.45334	9.98174	9.47160	10.52840	10.01826	10.54666	30
31	45377	98170	47207	52793	01830	54624	29
32	45419	98166	47253	52747	01834	54581	28
33	45462	98162	47299	52701	01838	54538	27
34	45505	98159	47346	52654	01841	54496	26
35	45547	98155	47392	52608	01845	54453	25
36	45589	98151	47438	52562	01849	54411	24
37	45632	98147	47484	52516	01853	54368	23
38	45674	98144	47530	52470	01856	54326	22
39	45716	98140	47576	52424	01860	54284	21
40	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	45801	98132	47668	52332	01868	54199	19
42	45843	98128	47714	52286	01871	54157	18
43	45885	98125	47760	52240	01875	54115	17
44	45927	98121	47806	52194	01879	54073	16
45	45969	98117	47852	52148	01883	54031	15
46	46011	98113	47897	52102	01887	53989	14
47	46053	98109	47943	52057	01890	53947	13
48	46095	98106	47989	52011	01894	53905	12
49	46136	98102	48034	51965	01898	53864	11
50	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	46220	98094	48126	51874	01906	53780	9
52	46262	98090	48171	51829	01910	53738	8
53	46303	98087	48217	51783	01913	53697	7
54	46345	98083	48262	51738	01917	53655	6
55	46386	98079	48307	51692	01921	53614	5
56	46428	98075	48353	51647	01925	53572	4
57	46469	98071	48398	51602	01929	53531	3
58	46511	98067	48443	51557	01933	53489	2
59	46552	98063	48489	51511	01937	53448	1
60	46594	98060	48534	51466	01940	53406	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

73 Degrees.

Artificial Sines, Tang. and Sec. 17 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant.	
0	9.46593	9.98060	9.48534	10.51466	10.01940	10.53407	60
1	46635	98056	48579	51421	01944	53365	59
2	46676	98052	48624	51376	01948	53324	58
3	46717	98048	48669	51331	01952	53283	57
4	46758	98044	48714	51286	01956	53242	56
5	46800	98040	48759	51241	01960	53200	55
6	46841	98036	48804	51196	01964	53159	54
7	46882	98032	48849	51151	01968	53118	53
8	46923	98029	48894	51106	01971	53077	52
9	46964	98025	48939	51061	01975	53036	51
10	9.47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	47045	98017	49029	50971	01983	52954	49
12	47086	98013	49073	50927	01987	52914	48
13	47127	98009	49118	50882	01991	52873	47
14	47168	98005	49163	50837	01995	52832	46
15	47209	98001	49207	50793	01999	52791	45
16	47240	97997	49252	50748	02003	52751	44
17	47290	97993	49296	50703	02006	52710	43
18	47330	97989	49341	50659	02010	52670	42
19	47371	97986	49385	50614	02014	52629	41
20	9.47411	9.97982	9.49430	10.50570	10.02018	10.52588	40
21	47452	97978	49474	50526	02022	52548	39
22	47492	97974	49519	50481	02026	52508	38
23	47533	97970	49563	50437	02030	52467	37
24	47573	97966	49607	50393	02034	52427	36
25	47613	97962	49651	50348	02038	52387	35
26	47654	97958	49696	50304	02042	52346	34
27	47694	97954	49740	50260	02046	52306	33
28	47734	97950	49784	50216	02050	52266	32
29	47774	97946	49828	50172	02054	52226	31
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	47854	97938	49916	50084	02062	52146	29
32	47894	97934	49960	50040	02066	52106	28
33	47934	97930	50004	49996	02070	52066	27
34	47974	97926	50048	49952	02074	52026	26
35	48014	97922	50092	49908	02078	51986	25
36	48054	97918	50136	49864	02082	51946	24
37	48094	97914	50180	49820	02086	51906	23
38	58133	97910	50223	49776	02090	51867	22
39	48173	97906	50267	49733	02094	51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	48252	97898	50355	49645	02102	51747	19
42	48292	97894	50398	49602	02106	51708	18
43	48332	97890	50442	49558	02110	51668	17
44	48371	97886	50485	49515	02114	51629	16
45	48411	97882	50529	49471	02118	51589	15
46	48450	97878	50572	49428	02122	51550	14
47	48489	97874	50616	49384	02126	51510	13
48	48529	97870	50659	49341	02130	51471	12
49	48568	97866	50703	49297	02134	51432	11
50	9.48607	9.97861	9.50746	10.49254	10.02139	10.51392	10
51	48647	97857	50789	49211	02143	51353	9
52	48686	97853	50833	49167	02147	51314	8
53	48725	97849	50876	49124	02151	51275	7
54	48764	97845	50919	49081	02155	51236	6
55	48803	97841	50962	49038	02159	51197	5
56	48842	97837	51005	48995	02163	51158	4
57	48881	97833	51048	48951	02167	51119	3
58	48920	97829	51092	48908	02171	51080	2
59	48959	97825	51135	48865	02175	51041	1
60	48998	97821	51178	48822	02179	51002	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

72 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co tang.	Secant.	Co-ſecant	
0	9.48998	9.97821	9.51178	10.48822	10.02179	10.51002	60
1	49037	97817	51221	48779	02183	50963	59
2	49076	97812	51264	48736	02188	50924	58
3	49115	97808	51306	48694	02192	50885	57
4	49153	97804	51349	48651	02196	50847	56
5	49192	97800	51392	48608	02200	50808	55
6	49231	97796	51435	48565	02204	50769	54
7	49269	97792	51478	48522	02208	50731	53
8	49308	97788	51520	48480	02212	50692	52
9	49347	97784	51563	48437	02216	50653	51
10	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	49424	97775	51648	48352	02225	50576	49
12	49462	97771	51691	48309	02229	50538	48
13	49500	97767	51734	48266	02233	50500	47
14	49539	97763	51776	48224	02237	50461	46
15	49577	97759	51819	48181	02241	50423	45
16	49615	97754	51861	48139	02246	50385	44
17	49654	97750	51903	48097	02250	50346	43
18	49692	97746	51946	48054	02254	50308	42
19	49730	97742	51988	48012	02258	50270	41
20	9.49768	9.97738	9.52031	10.47969	10.02262	10.50232	40
21	49806	97733	52073	47937	02266	50194	39
22	49840	97729	52115	47885	02271	50156	38
23	49882	97725	52157	47843	02275	50118	37
24	49920	97721	52200	47800	02279	50080	36
25	49958	97717	52242	47758	02283	50042	35
26	49996	97713	52284	47716	02287	50004	34
27	50034	97708	52326	47674	02292	49966	33
28	50072	97704	52368	47632	02296	49928	32
29	50110	97700	52410	47590	02300	49890	31
30	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	50185	97691	52494	47506	02309	49815	29
32	50223	97687	52536	47464	02313	49777	28
33	50261	97683	52578	47422	02317	49739	27
34	50298	97679	52620	47380	02321	49702	26
35	50336	97674	52661	47339	02326	49664	25
36	50373	97670	52703	47297	02330	49626	24
37	50411	97666	52745	47255	02334	49589	23
38	50448	97662	52787	47213	02338	49551	22
39	50486	97657	52829	47171	02343	49514	21
40	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	50561	97649	52912	47088	02351	49439	19
42	50598	97645	52953	47047	02355	49402	18
43	50635	97640	52995	47005	02360	49365	17
44	50673	97636	53037	46963	02364	49327	16
45	50710	97632	53078	46922	02368	49290	15
46	50747	97627	53120	46880	02372	49253	14
47	50784	97623	53161	46839	02377	49216	13
48	50821	97619	53202	46797	02381	49179	12
49	50858	97615	53245	46756	02385	49142	11
50	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	50933	97606	53327	46673	02394	49067	9
52	50970	97602	53368	46632	02398	49030	8
53	51006	97597	53409	46591	02403	48993	7
54	51043	97593	53450	46550	02407	48957	6
55	51080	97589	53492	46508	02411	48920	5
56	51117	97584	53533	46467	02416	48883	4
57	51154	97580	53574	46426	02420	48846	3
58	51191	97576	53615	46385	02424	48809	2
59	51227	97571	53656	46344	02429	48773	1
60	51264	97567	53697	46303	02433	48736	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

71 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9·51264	9·97567	9·53697	10.46303	10.02433	10.48736	60
1	51301	97563	53738	46262	02437	48699	59
2	51337	97558	53779	46221	02442	48662	58
3	51374	97554	53820	46180	02446	48626	57
4	51411	97550	53861	46139	02450	48589	56
5	51447	97545	53902	46098	02455	48553	55
6	51484	97541	53943	46057	02459	48516	54
7	51520	97536	53984	46016	02464	48480	53
8	51557	97532	54025	45975	02468	48443	52
9	51593	97528	54065	45935	02472	48407	51
10	9·51629	9·97523	9·54106	10.45894	10.02477	10.48371	50
11	51666	97519	54147	45853	02481	48334	49
12	51702	97514	54187	45813	02485	48298	48
13	51738	97510	54228	45772	02490	48262	47
14	51774	97506	54269	45731	02494	58226	46
15	51811	97501	54309	45691	02499	48189	45
16	51847	97497	50350	45650	02503	48153	44
17	51883	97492	54390	45610	02508	48117	43
18	51919	97488	54431	45569	02521	48081	42
19	51955	97484	54471	45529	02516	48045	41
20	9·51991	9·97479	9·54512	10.45488	10.02521	10.48009	40
21	52027	97475	54552	45448	02525	47973	39
22	52063	97470	54593	45407	02530	47937	38
23	52099	97466	54633	45367	02534	47901	37
24	52135	97461	54673	45326	02539	47865	36
25	52171	97457	54714	45286	02543	47829	35
26	52207	97452	54754	45246	02547	47793	34
27	52242	97448	54794	45206	02552	47758	33
28	52278	97444	54835	45165	02556	47722	32
29	52314	97439	54875	45125	02561	47686	31
30	9·52350	9·97435	9·54915	10.45085	10.02565	10.47650	30
31	52385	97430	54955	45045	02570	47615	29
32	52421	97426	54995	45005	02574	47579	28
33	52456	97421	55035	44965	02579	47544	27
34	52492	97417	55075	44925	02583	47508	26
35	52527	97412	55115	44885	02588	47473	25
36	52563	97408	55155	44845	02592	47437	24
37	52598	97403	55195	44805	02597	47402	23
38	52634	97399	55235	44765	02601	47366	22
39	52669	97394	55275	44725	02606	47331	21
40	9·52705	9·97390	9·55315	10.44685	10.02610	10.47295	20
41	52740	97385	55355	44645	02615	47260	19
42	52775	97381	55395	44605	02619	47225	18
43	52810	97376	55434	44566	02624	47189	17
44	52846	97372	55474	44526	02628	47154	16
45	52881	97367	55514	44486	02633	47119	15
46	52916	97362	55554	44446	02537	47084	14
47	52951	97358	55593	44407	02642	47049	13
48	52986	97353	55633	44367	02647	47014	12
49	53021	97349	55673	44327	02651	46979	11
50	9·53056	9·97344	9·55712	10 44288	10.02656	10.46944	10
51	53091	97340	55752	44248	02660	46908	9
52	53126	97335	55791	44209	02665	46873	8
53	53161	97331	55831	44169	02669	46839	7
54	53196	97326	55870	44130	02674	46804	6
55	53231	97322	55910	44090	02678	46769	5
56	53266	97317	55949	44051	02683	46734	4
57	53301	97312	55989	44011	02688	46699	3
58	53336	97308	56028	43972	02692	46664	2
59	53370	97303	56067	43933	02697	46630	1
60	53405	97299	56107	43893	02701	46595	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

79 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co secant	
0	9.53405	9.97299	9.56107	10.43893	10.02701	10.46595	60
1	53440	97294	56146	43854	02706	46560	59
2	53475	97289	56185	43815	02711	46525	58
3	53500	97285	56224	43776	02715	46491	57
4	53544	97280	56264	43736	02720	46456	56
5	53578	97275	56303	43697	02724	46422	55
6	53613	97271	56342	43658	02729	46388	54
7	53647	97266	56381	43619	02734	46353	53
8	53682	97262	56420	43580	02737	46318	52
9	53716	97257	56459	43541	02743	46284	51
10	9.53751	9.97252	9.56498	10.43502	10.02748	10.46249	50
11	53785	97248	56537	43463	02752	46215	49
12	53819	97243	56576	43424	02757	46181	48
13	53854	97238	56615	43385	02762	46146	47
14	53888	97234	56654	43346	02766	46112	46
15	53922	97229	56693	43307	02771	46078	45
16	53957	97224	56732	43268	02776	46043	44
17	53991	97220	56771	43229	02780	46009	43
18	54025	97215	56810	43190	02785	45975	42
19	54059	97210	56849	43151	02789	45941	41
20	9.54093	9.97206	9.56887	10.43113	10.02794	10.45909	40
21	54127	97201	56926	43074	02799	45873	39
22	54161	97196	56965	43035	02804	45839	38
23	54195	97192	57004	42996	02808	45805	37
24	54229	97187	57042	42958	02813	45771	36
25	54263	97182	57081	42919	02818	45737	35
26	54297	97178	57120	42880	02822	45703	34
27	54331	97173	57158	42842	02827	45669	33
28	54365	97168	57197	42803	02832	45635	32
29	54399	97163	57235	42765	02837	45601	31
30	9.54432	9.97159	9.57274	10.42726	10.02841	10.45567	30
31	54466	97154	57312	42688	02846	45534	29
32	54500	97149	57351	42649	02851	45500	28
33	54534	97145	57389	42611	02855	45466	27
34	54567	97140	57428	42572	02860	45433	26
35	54601	97135	57466	42534	02865	45399	25
36	54635	97130	57504	42496	02870	45365	24
37	54668	97126	57543	42457	02874	45332	23
38	54702	97121	57581	42419	02879	45298	22
39	54735	97116	57619	42381	02884	45265	21
40	9.54769	9.97111	9.57658	10.42342	10.02889	10.45231	20
41	54802	97106	57696	42304	02893	45198	19
42	54836	97102	57734	42266	02898	45164	18
43	54869	97097	57772	42228	02903	45131	17
44	54903	97092	57810	42190	02908	45097	16
45	54936	97087	57849	42151	02913	45064	15
46	54969	97083	57887	42113	02917	44031	14
47	55003	97078	57925	42075	02922	44997	13
48	55036	97073	57963	42037	02927	44964	12
49	55069	97068	58001	41999	02932	44931	11
50	9.55102	9.97063	9.58039	10.41961	10.02937	10.44898	10
51	55136	97059	58077	41923	02941	44864	9
52	55169	97054	58115	41885	02946	44831	8
53	55202	97049	58153	41847	02951	44798	7
54	55235	97044	58191	41809	02956	44765	6
55	55268	97039	58229	41771	02961	44732	5
56	55301	97034	58267	41733	02965	44699	4
57	55334	97030	58304	41696	02970	44666	3
58	55367	97025	58342	41658	02975	44633	2
59	55400	97020	58380	41620	02980	44600	1
60	55433	97015	58418	41582	02985	44567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

69 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang	Secant.	Co-ſecant.	
0	9.55433	9.97015	9.58418	10.41582	10.02985	10.44567	60
1	55466	97010	58455	41545	02990	44534	59
2	55499	97005	58493	41507	02995	44501	58
3	55531	97001	58531	41469	02999	44468	57
4	55564	96996	58569	41431	03004	44436	56
5	55597	96991	58606	41394	03009	44403	55
6	55630	96986	58644	41356	03014	44370	54
7	55663	96981	58681	41319	03019	44337	53
8	55695	96976	58719	41281	03024	44305	52
9	55728	96971	58757	41243	03029	44272	51
10	9.55761	9.96966	9.58794	10.41206	10.03034	10.44239	50
11	55793	96962	58832	41168	03038	44207	49
12	55826	96957	58869	41131	03043	44104	48
13	55858	96952	58907	41093	03048	44142	47
14	55891	96947	58944	41056	03053	44109	46
15	55923	96942	58981	41019	03058	44077	45
16	55956	96937	59019	40981	03063	44044	44
17	55988	96932	59056	40944	03068	44012	43
18	56021	96927	59094	40906	03073	43979	42
19	56053	96922	59131	40869	03078	43947	41
20	9.56085	9.96917	9.59168	10.40832	10.03083	10.43914	40
21	56118	96912	59205	40795	03088	43882	39
22	56150	96907	59243	40757	03093	43850	38
23	56182	96903	59280	40720	03097	43818	37
24	56215	96898	59317	40683	03102	43785	36
25	56247	96893	59354	40646	03107	43753	35
26	56279	96888	59391	40609	03112	43721	34
27	56311	96883	59429	40571	03117	43689	33
28	56343	96878	59466	40534	03122	43657	32
29	56375	96873	59503	40497	03127	43625	31
30	9.56408	9.96868	9.59540	10.40460	10.03132	10.43592	30
31	56440	96863	59577	40423	03137	43560	29
32	56472	96858	59614	40386	03142	43528	28
33	56504	96853	59651	40349	03147	43496	27
34	56536	96848	59688	40312	03152	43464	26
35	56568	96843	59725	40275	03157	43432	25
36	56599	96838	59762	40238	03162	43400	24
37	56631	96833	59799	40201	03167	43369	23
38	56663	96828	59835	40165	03172	43337	22
39	56695	96823	59872	40128	03177	43305	21
40	9.56727	9.96818	9.59909	10.40091	10.03182	10.43273	20
41	56759	96813	59946	40054	03187	43241	19
42	56790	96808	59983	40017	03192	43210	18
43	56822	96803	60019	39981	03197	43178	17
44	56854	96798	60056	39944	03202	43146	16
45	56886	96793	60093	39907	03207	43114	15
46	56917	96788	60130	39870	03212	43083	14
47	56949	96783	60166	39834	03217	43051	13
48	56980	96778	60203	39797	03222	43020	12
49	57012	96772	60239	39760	03228	42988	11
50	9.57044	9.96767	9.60276	10.39724	10.03232	10.42956	10
51	57075	96762	60313	39687	03238	42925	9
52	57107	96757	60349	39651	03243	42893	8
53	57138	96752	60386	39614	03248	42862	7
54	57169	96747	60422	39578	03253	42830	6
55	57201	96742	60459	39541	03258	42790	5
56	57232	96737	60495	39505	03263	42768	4
57	57264	96732	60532	39468	03268	42736	3
58	57295	96727	60568	39432	03273	42705	2
59	57326	96722	60605	39395	03278	42674	1
60	57357	96717	60641	39359	03283	42642	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

68 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.57358	9.96717	9.60641	10.39359	10.03283	10.42642	60
1	57389	96711	60677	39323	03289	42611	59
2	57420	96706	60714	39286	03294	42580	58
3	57451	96701	60750	39250	03299	42549	57
4	57482	96696	60786	39214	03304	42518	56
5	57514	96691	60823	39177	03309	42486	55
6	57545	96686	60859	39141	03314	42455	54
7	57576	96681	60895	39105	03319	42420	53
8	57667	96676	60931	39069	03324	42393	52
9	37638	96670	60967	39033	03330	42362	51
10	9.57669	9.96665	9.61024	10.38996	10.03335	10.42331	50
11	57700	96660	61040	38960	03340	42300	49
12	57731	96655	61076	38924	03345	42269	48
13	57762	96650	61122	38888	03350	42238	47
14	57793	96645	61148	38852	03355	42207	46
15	57824	96640	61184	38816	03360	42176	45
16	57854	96634	61220	38780	03366	42145	44
17	57885	96629	61256	38744	03371	42115	43
18	57916	96624	61292	38708	03376	42084	42
19	57947	96619	61328	38672	03381	42053	41
20	9.57978	9.966614	9.61364	10.38636	10.03386	10.42022	40
21	58008	96608	61400	38600	03392	41992	39
22	58039	96603	61436	38564	03397	41961	38
23	58070	96598	61472	38528	03402	41930	37
24	58100	96593	61508	38492	03407	41899	36
25	58131	96588	61544	38456	03412	41869	35
26	58162	96582	61579	38421	03418	41838	34
27	58192	96577	61615	38385	03423	41808	33
28	58223	96572	61651	38349	03428	41777	32
29	58253	96567	61687	38313	03433	41747	31
30	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	30
31	58314	96556	61758	38242	03444	41686	29
32	58345	96551	61794	38206	03449	41655	28
33	58375	96546	61830	38170	03454	41625	27
34	58406	96541	61865	38135	03459	41594	26
35	58436	96535	61901	38099	03465	41564	25
36	58467	96530	61936	38063	03470	41533	24
37	58497	96525	61972	38028	03475	41503	23
38	58527	96520	62008	37992	03480	41473	22
39	58557	96514	62043	37957	03486	41443	21
40	9.58588	9.96509	9.62079	10.37921	10.03491	10.41412	20
41	58618	96504	62114	37886	03496	41382	19
42	58648	96498	62150	37850	03502	41352	18
43	58678	96493	62185	37815	03507	41322	17
44	58708	96488	62221	37779	03512	41291	16
45	58739	96483	62256	37744	03517	41261	15
46	58769	96477	62291	37708	03523	41231	14
47	58799	96472	62327	37673	03528	41201	13
48	58829	96467	62362	37638	03533	41171	12
49	58859	96461	62398	37602	03539	41141	11
50	9.58889	9.986456	9.62433	10.37567	10.03544	10.41111	10
51	58919	96451	62468	37532	03549	41081	9
52	58949	96445	62504	37496	03555	41051	8
53	5 979	96440	62539	37461	03560	41021	7
54	59009	96435	62574	37426	03565	40991	6
55	59039	96429	62609	37391	03571	40961	5
56	59069	96424	62645	37355	03576	40931	4
57	59098	96419	62680	37320	03581	40902	3
58	59128	96413	62715	37285	03587	40872	2
59	59158	96408	62750	37250	03592	40842	1
60	59188	96403	62785	37215	03597	40812	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.59188	9.96404	9.62785	10.37215	10.03597	10.40812	60
1	59217	96397	62820	37180	03603	40782	59
2	59247	96392	62855	37145	03608	40753	58
3	59277	96386	62890	37110	03613	40723	57
4	59307	96381	62926	37074	03619	40693	56
5	59336	96376	62961	37039	03624	40664	55
6	59366	96370	62996	37004	03630	40634	54
7	59396	96364	63031	36969	03635	40604	53
8	59425	96360	63066	36934	03640	40575	52
9	59455	96354	63101	36899	03646	40545	51
10	9.59484	9.96349	9.63135	10.36865	10.03651	10.40516	50
11	59514	96343	63170	36830	03657	40486	49
12	59543	96338	63205	36795	03662	40457	48
13	59573	96333	63240	36760	03667	40427	47
14	59602	96327	63275	36725	03673	40398	46
15	59632	96322	63310	36690	03678	40368	45
16	59661	96316	63345	36655	03684	40339	44
17	59690	96311	63379	36620	03689	40310	43
18	59720	96305	63414	36586	03695	40280	42
19	59749	96300	63449	36551	03700	40251	41
20	9.59778	9.96294	9.63484	10.36516	10.03706	10.40222	40
21	59808	96289	63519	36481	03711	40192	39
22	59837	96284	63553	36447	03716	40163	38
23	59896	96278	63588	36412	03722	40134	37
24	59895	96273	63623	36377	03727	40105	36
25	59924	96267	63657	36343	03733	40076	35
26	59954	96262	63692	36308	03738	40046	34
27	59983	96256	93726	36274	03744	40017	33
28	60012	96251	63761	36239	03749	39988	32
29	60041	96245	63796	36204	03755	39959	31
30	9.60070	9.96240	9.63830	10.36170	10.03760	10.39930	30
31	60099	96234	63865	36135	03766	39901	29
32	60128	96228	63899	36101	03771	39872	28
33	60156	96223	63934	36066	03777	39843	27
34	60186	96217	63968	36032	03783	39814	26
35	60215	96212	64003	35997	03788	39785	25
36	60244	96207	64037	35963	03794	39756	24
37	60273	96201	64072	35928	03798	39727	23
38	60302	96196	64106	35894	03804	39698	22
39	60331	96190	64140	35860	03810	39669	21
40	9.60359	9.96185	9.64175	10.35825	10.03815	10.39641	20
41	60388	96179	64209	35791	03821	39612	19
42	60417	96174	64243	35757	03826	39583	18
43	60446	96168	64278	35722	03832	39554	17
44	60474	96162	64312	35688	03838	39525	16
45	60503	96157	64346	35654	03843	39497	15
46	60532	96151	64381	35619	03849	39468	14
47	60561	96146	64415	35585	03855	39439	13
48	60589	96140	64449	35551	03860	39411	12
49	60618	96135	64483	35517	03866	39382	11
50	9.60646	9.96129	9.64517	10.35483	10.03871	10.39353	10
51	60675	96124	64552	35448	03877	39325	9
52	60704	96113	64586	35414	03882	39296	8
53	60732	96112	64620	35380	03888	39268	7
54	60761	96107	64654	35346	03893	39239	6
55	60789	96101	64688	35312	03999	39211	5
56	60818	96095	64722	35278	03905	39182	4
57	60846	96090	64756	35244	03910	39154	3
58	60874	96084	64790	35210	03915	39125	2
59	60903	96079	64824	35176	03921	39097	1
60	60931	96073	64858	35142	03927	39069	0
	Co-ſine	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.60931	9.96073	9.64858	10.35142	10.03927	10.39069	60
1	60960	96067	64892	35108	03933	39040	59
2	60988	96062	64926	35074	03938	39012	58
3	61016	96056	64960	35040	03944	38984	57
4	61045	96050	64994	35006	03950	38955	56
5	61073	96045	65028	34972	03955	38927	55
6	61101	96039	65062	34938	03961	38899	54
7	61129	96034	65096	34904	03966	38871	53
8	61158	96028	65130	34870	03972	38842	52
9	61186	96022	65164	34836	03978	38814	51
10	9.61214	9.96017	9.65197	10.34803	10.03983	10.38786	50
11	61242	96011	65231	34769	03989	38758	49
12	61270	96005	65265	34735	03995	38730	48
13	61298	95999	65299	34701	04000	38702	47
14	61326	95994	65333	34667	04006	38674	46
15	61354	95988	65366	34634	04012	38646	45
16	61382	95982	65400	34600	04018	38618	44
17	61411	95977	65434	34566	04023	38589	43
18	61438	95971	65467	34533	04029	38561	42
19	61466	95965	65501	34499	04035	38534	41
20	9.61494	9.95960	9.65535	10.34466	10.04040	10.38506	40
21	61522	95954	65568	34432	04046	38478	39
22	61550	95948	65602	34398	04052	38450	38
23	61578	95942	65636	34364	04058	38422	37
24	61606	95937	65669	34331	04063	38394	36
25	61634	95931	65702	34297	04069	38366	35
26	61662	95925	65736	34264	04075	38338	34
27	61689	95920	65770	34230	04080	38311	33
28	61717	95914	65803	34197	04086	38283	32
29	61745	95908	65837	34163	04092	38255	31
30	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	61800	95896	65904	34096	04103	38200	29
32	61828	95891	65937	34063	04109	38172	28
33	61856	95885	65971	34029	04115	38144	27
34	61883	95879	66004	33996	04121	38117	26
35	61911	95873	66038	33962	04127	38089	25
36	61940	95868	66071	33929	04132	38061	24
37	61966	95862	66104	33896	04138	38034	23
38	62994	95856	66138	33862	04144	38006	22
39	62021	95850	66171	33829	04150	37979	21
40	9.62049	9.95844	9.66204	10.33796	10.04156	10.37951	20
41	62076	95839	66238	33762	04161	37924	19
42	62108	95833	66271	33729	04167	37896	18
43	62131	95827	66304	53696	04173	37869	17
44	62159	95821	66333	33663	04179	37841	16
45	62186	95815	66371	33629	04185	37814	15
46	62214	95810	66404	33596	04190	37786	14
47	62241	95804	66437	33563	04196	37759	13
48	62268	95798	66470	33530	04202	37732	12
49	62296	95792	66503	33497	04208	37704	11
50	9.62323	9.95786	9.66537	10.33463	10.04214	10.37677	10
51	62350	95780	66570	33430	04220	37650	9
52	62377	95775	66603	33397	04225	37623	8
53	62405	95769	66636	33364	04231	37595	7
54	62432	95763	66669	33331	04237	37568	6
55	62459	95757	66702	33298	04243	37541	5
56	62486	95751	66735	33265	04249	37514	4
57	62513	95745	66768	33232	04255	37487	3
58	62541	95739	66801	33199	04261	37459	2
59	62568	95733	66834	33166	04267	37432	1
60	62595	95728	66867	33133	04272	37405	0
	Co-ſine	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

65 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.62595	9.95728	9.66867	10.3 133	10.04272	10.37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32837	04326	37162	51
10	9.62865	9.95668	9.67196	10.32804	10.04332	10.37135	50
11	62892	95662	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32673	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63026	95633	67393	32607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	33542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	63159	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63212	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67980	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95513	68044	31956	04487	36443	24
37	63583	95507	68077	31923	04493	36417	23
38	63610	95500	68109	31891	04500	36390	22
39	63636	95494	68142	31858	04506	36364	21
40	9.63662	9.95488	9.68174	10.31826	10.04512	10.36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63793	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95434	68465	31535	04566	36102	11
50	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	63950	95421	68529	31471	04579	36050	9
52	63976	95415	68561	31439	04585	36024	8
53	64002	95409	68593	31407	04591	35998	7
54	64028	95403	68626	31374	04597	35972	6
55	64054	95397	68658	31342	04603	35946	5
56	64080	95391	68690	31310	04609	35920	4
57	64106	95384	68722	31278	04616	35894	3
58	64132	95378	68754	31246	04622	35868	2
59	64158	95372	68786	31214	04628	35842	1
60	64184	95366	68818	31182	04634	35816	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

64 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co tang.	Secant.	Co-ſecant	
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	64210	95360	68850	31150	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95348	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35687	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30958	04677	35635	53
8	64391	95317	69074	30926	04683	35609	52
9	64417	95310	69106	30894	04690	35583	51
10	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95286	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69298	30702	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95252	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69584	30416	04783	35200	36
25	64826	95211	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35073	31
30	9.64953	9.95179	9.69774	10.30226	10.04821	10.35047	30
31	64978	95173	69805	30195	04827	35022	29
32	65003	95167	69837	30163	04833	34997	28
33	65029	95160	69868	30132	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04997	34745	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04910	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29691	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34420	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94994	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co-ſine.	Sine.	Co-tang.	Tangent	Co-ſecant	Secant.	M.

63 Degrees.

M.	Sine.	Co-ſine	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34271	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34098	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94910	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33975	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94884	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28568	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	38608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33293	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72329	27678	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72509	27493	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

62 Degrees.

M.	Sine.	Co-ſine.	Tangent	Co-tang.	Secant.	Co ſecant	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32625	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05858	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	81695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25833	05769	31603	7
54	68420	94224	74196	25803	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68511	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

61 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74465	25535	05839	31375	57
4	68648	94154	74495	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25417	05867	31384	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94098	74732	25268	05802	31170	48
13	68852	94090	74762	25238	05910	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74851	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05952	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74998	25002	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05988	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69212	93977	75235	24765	06023	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93963	75294	24706	06037	30744	29
32	69279	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24588	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93919	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24441	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06110	30499	18
43	69523	93876	75647	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75735	24265	06145	30411	14
47	69611	93847	75764	24236	06153	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93819	75881	24119	06181	30301	9
52	69721	93811	75910	24090	06189	30279	8
53	69743	93804	75939	24061	06196	30256	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06210	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	69919	93746	76173	23827	06254	30081	59
2	69941	93738	76202	23798	06261	30059	58
3	69963	93731	76231	23769	06269	30037	57
4	69984	93724	76261	23739	06276	30016	56
5	70006	93717	76290	23710	06283	29994	55
6	70028	93709	76319	23681	06291	29972	54
7	70050	93702	76348	23652	06298	29950	53
8	70072	93695	76377	23623	06305	29928	52
9	70093	93687	76406	23594	06313	29907	51
10	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	70137	93673	76464	23536	06327	29864	49
12	70159	93665	76493	23507	06335	29841	48
13	70180	93658	76522	23478	06342	29820	47
14	70202	93650	76551	23449	06350	29798	46
15	70224	93643	76580	23420	06357	29776	45
16	70245	93636	76609	23391	06364	29755	44
17	70267	93628	76639	23361	06372	29733	43
18	70288	93621	76668	23332	06379	29712	42
19	70310	93614	76697	23303	06386	29690	41
20	9.70332	9.93606	9.76725	10.23274	10.06394	10.29668	40
21	70353	93599	76754	23246	06401	29647	39
22	70375	93591	76783	23217	06409	29625	38
23	70396	93584	76812	23188	06416	29604	37
24	70418	93577	76841	23159	06423	29582	36
25	70439	93569	76870	23130	06431	29561	35
26	70461	93562	76899	23101	06438	29539	34
27	70482	93554	76928	23073	06446	29518	33
28	70504	93547	76957	23043	06453	29496	32
29	70525	93539	76986	23014	06461	29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
31	70568	93525	77044	22956	06475	29432	29
32	70590	93517	77073	22927	06483	29410	28
33	70611	93510	77101	22899	06490	29389	27
34	70633	93502	77130	22870	06498	29367	26
35	70654	93495	77159	22841	06505	29346	25
36	70675	93487	77188	22812	06513	29325	24
37	70697	93480	77217	22783	06520	29303	23
38	70718	93472	77246	22754	06528	29282	22
39	70739	93465	77274	22726	06535	29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	70782	93450	77332	22668	06550	29218	19
42	70803	93442	77361	22639	06558	29197	18
43	70824	93435	77390	22610	06565	29175	17
44	70846	93427	77418	22582	06573	29154	16
45	70867	93420	77447	22553	06580	29133	15
46	70888	93412	77476	22524	06588	29112	14
47	70909	93405	77505	22495	06595	29091	13
48	70931	93397	77533	22467	06603	29069	12
49	70952	93390	77562	22438	06610	29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	70994	93375	77619	22381	06625	29006	9
52	71015	93367	77648	22352	06653	28985	8
53	71036	93360	77677	22323	06640	28964	7
54	71058	93352	77705	22294	06648	28942	6
55	71079	93344	77734	22266	06656	28921	5
56	71100	93337	77763	22237	06663	28900	4
57	71121	93329	77791	22208	06671	28879	3
58	71142	93322	77820	22180	06678	28858	2
59	71163	93314	77849	22151	06686	28837	1
60	71184	93307	77877	22123	06693	28816	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

59 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.71184	9.93307	9.79877	10.22123	10.06693	10.28816	60
1	71205	93299	79906	22094	06701	28795	59
2	71226	93291	79935	22065	06709	28774	58
3	71247	93284	79963	22037	06716	28753	57
4	71268	93276	79992	22008	06724	28732	56
5	71289	93269	78021	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21923	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06792	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71519	93184	78334	21666	06816	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21580	06839	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28357	38
23	71664	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93107	78618	21382	06893	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21296	06916	28212	31
30	9.71809	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	75891	93046	78845	21155	06954	28119	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78959	21041	06985	28027	22
39	71993	93007	78987	21013	06993	28007	21
40	9.72014	9.92999	9.79-15	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27965	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92975	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27761	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79495	20505	07134	27640	3
58	72381	92858	79523	20477	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	27579	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

58 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	60
1	72441	92834	79607	20393	07166	27559	59
2	72461	92826	79635	20365	07174	27539	58
3	72482	92818	79663	20337	07182	27518	57
4	72502	92810	79691	20309	07190	27498	56
5	72522	92803	79719	20281	07197	27478	55
6	72542	92795	79747	20253	07205	27458	54
7	72562	92787	79776	20224	07213	27438	53
8	72582	92779	79804	20196	07221	27418	52
9	72602	92771	79832	20168	07229	27398	51
10	9.72622	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	72643	92755	79888	20112	07243	27357	49
12	72663	92747	79916	20084	07253	27337	48
13	72683	92739	79944	20056	07261	27317	47
14	72703	92731	79972	20028	07269	27297	46
15	72723	92723	80000	20000	07277	27277	45
16	72743	92715	80028	19972	07285	27257	44
17	72763	92707	80056	19944	07293	27237	43
18	72783	92699	80084	19916	07301	27217	42
19	72803	92691	80112	19888	07309	27197	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	72843	92675	80168	19832	07325	27157	39
22	72863	92667	80195	19805	07333	27137	38
23	72883	92659	80223	19778	07341	27117	37
24	72902	92651	80251	19749	07349	27098	36
25	72922	92643	80279	19721	07357	27078	35
26	72942	92635	80307	19693	07365	27058	34
27	72962	92627	80335	19665	07373	27038	33
28	72982	92619	80363	19637	07381	27018	32
29	73002	92611	80391	19609	07389	26998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	73041	92595	80447	19553	07405	26959	29
32	73061	92587	80474	19526	07413	26939	28
33	73081	92579	80502	19498	07421	26919	27
34	73101	92571	80530	19470	07429	26899	26
35	73121	92563	80558	19442	07437	26879	25
36	73140	92556	80585	19414	07445	26860	24
37	73160	92546	80614	19386	07454	26840	23
38	73180	92538	80642	19358	07462	26820	22
39	73200	92530	80669	19331	07470	26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	73239	92514	80725	19275	07486	26761	19
42	73259	92506	80753	19247	07494	26741	18
43	73278	92498	80781	19219	07502	26722	17
44	73298	92490	80808	19192	07510	26702	16
45	73318	92482	80836	19164	07518	26682	15
46	73337	92473	80864	19136	07527	26663	14
47	73357	92465	80892	19108	07535	26643	13
48	73377	92457	80919	19081	07543	26623	12
49	73396	92449	80947	19053	07551	26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	73435	92433	81003	18997	07567	26565	9
52	73455	92425	81030	18970	07575	26545	8
53	73474	92416	81058	18942	07584	26526	7
54	73494	92408	81086	18914	07592	26506	6
55	73513	92400	81113	18887	07600	26487	5
56	73533	92392	81141	18859	07608	26467	4
57	73552	92384	81169	18831	07616	26448	3
58	73572	92376	81196	18804	07624	26428	2
59	73591	92367	81224	18776	07633	26409	1
60	73611	92359	81252	18748	07641	26389	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

57 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant.	
0	9·73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81417	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9·73805	9.92277	9.81528	10·18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9·73997	9.92194	9.81803	10·18197	10.07806	10.26002	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74112	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9·74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17784	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9·74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82434	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74593	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9·74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

56 Degrees.

Artificial Sines, Tang. and Sec. 34 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.74756	9.91857	9.82899	10.17101	10.08143	10.25244	60
1	74775	91849	82926	17074	08151	25225	59
2	74794	91840	82953	17047	08160	25206	58
3	74812	91832	82980	17020	08168	25188	57
4	74831	91823	83008	16992	08177	25169	56
5	74850	91815	83035	16965	08185	25150	55
6	74868	91806	83062	16938	08194	25132	54
7	74887	91798	83089	16911	08202	25113	53
8	74906	91789	83116	16883	08211	25094	52
9	74924	91780	83144	16856	08219	25076	51
10	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	74961	91763	83198	16802	08237	25039	49
12	74980	91755	83225	16775	08245	25020	48
13	74999	91746	83252	16748	08254	25001	47
14	75017	91738	83279	16720	08262	25983	46
15	75036	91729	83307	16693	08271	24964	45
16	75054	91720	83334	16666	08280	24946	44
17	75073	91712	83361	16639	08288	24927	43
18	75091	91703	83388	16612	08297	24909	42
19	75110	91694	83415	16585	08305	24890	41
20	9.75128	9.91686	9.83442	10.16558	10.08314	10.24872	40
21	75147	91677	83470	16530	08323	24853	39
22	75165	91668	83497	16503	08331	24835	38
23	75184	91660	83524	16476	08340	24816	37
24	75202	91651	83551	16449	08349	24798	36
25	75221	91643	83578	16422	08357	24779	35
26	75239	91634	83605	16395	08366	24761	34
27	75258	91625	83632	16368	08375	24742	33
28	75276	91617	83659	16341	08383	24724	32
29	75294	91608	83686	16314	08392	24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	75331	91591	83740	16260	08409	24669	29
32	75349	91582	83767	16232	08418	24650	28
33	75368	91573	83795	16205	08427	24632	27
34	75386	91565	83822	16178	08435	24614	26
35	75405	91556	83849	16151	08444	24595	25
36	75423	91547	83876	16124	08453	24577	24
37	75441	91538	83903	16097	08462	24559	23
38	75459	91530	83930	16070	08470	24541	22
39	75478	91521	83957	16043	08479	24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	75514	91503	84011	15989	08496	24486	19
42	75533	91495	84038	15962	08505	24467	18
43	75551	91486	84065	15935	08514	24449	17
44	75569	91477	84092	15908	08523	24431	16
45	75587	91468	84119	15881	08531	24413	15
46	75605	91460	84146	15854	08540	24395	14
47	75624	91451	84173	15827	08549	24376	13
48	75642	91442	84200	15800	08558	24358	12
49	75660	91433	84227	15773	08567	24340	11
50	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	75696	91416	84280	15720	08584	24304	9
52	75714	91407	84307	15693	08593	24286	8
53	75732	91398	84334	15666	08602	24267	7
54	75751	91389	84361	15639	08611	24249	6
55	75769	91381	84388	15612	08619	24231	5
56	75787	91372	84415	15585	08628	24213	4
57	75805	91363	84442	15558	08637	24195	3
58	75823	91354	84469	15531	08646	24177	2
59	75841	91345	84496	15504	08655	24159	1
60	75859	91336	84523	15477	08664	24141	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

55 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	60
1	75877	91328	84550	15450	08672	24123	59
2	75895	91319	84576	15424	08681	24105	58
3	75913	91310	84603	15397	08690	24087	57
4	75931	91301	84630	15370	08699	24069	56
5	75949	91292	84657	15343	08708	24051	55
6	75967	91283	84684	15316	08717	24033	54
7	75985	91274	84711	15289	08726	24015	53
8	76003	91267	84738	15262	08734	23997	52
9	76021	91257	84764	15236	08743	23979	51
10	9.76039	9.91248	9.84791	10.15209	10.08752	10.23961	50
11	76057	91239	84818	15182	08761	23943	49
12	76075	91230	84845	15155	08770	23925	48
13	76093	91221	84872	15128	08779	23907	47
14	76111	91212	84899	15101	08788	23889	46
15	76129	91203	84925	15075	08797	23871	45
16	76146	91194	84952	15048	08806	23854	44
17	76164	91185	84979	15021	08815	23836	43
18	76182	91176	85006	14994	08824	23818	42
19	76200	91167	85033	14967	08833	23800	41
20	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	76236	91149	85086	14914	08851	23774	39
22	76253	91141	85113	14887	08859	23747	38
23	76271	91132	85140	14860	08868	23729	37
24	76289	91123	85166	14834	08877	23711	36
25	76307	91114	85193	14807	08886	23693	35
26	76324	91105	85220	14780	08895	23676	34
27	76342	91096	85247	14753	08904	23658	33
28	76360	91087	85273	14727	08913	23640	32
29	76378	91078	85300	14700	08922	23622	31
30	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
31	76413	91060	85354	14646	08940	23587	29
32	76431	91051	85380	14620	08949	23569	28
33	76448	91042	85407	14593	08958	23552	27
34	76466	91034	85434	14566	08966	23534	26
35	76484	91023	85460	14540	08977	23516	25
36	76501	91014	85487	14513	08987	23499	24
37	76519	91005	85514	14486	08995	23481	23
38	76537	90996	85540	14460	09004	23463	22
39	76554	90987	85567	14433	09013	23446	21
40	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	76590	90969	85620	14380	09031	23410	19
42	76607	90960	85647	14353	09040	23393	18
43	76625	90951	85674	14326	09049	23375	17
44	76642	90942	85700	14300	09058	23358	16
45	76660	90933	85727	14273	09067	23340	15
46	76677	90924	85754	14246	09076	23323	14
47	76695	90915	85780	14220	09085	23305	13
48	76712	90905	85807	14193	09095	23288	12
49	76730	90896	85834	14166	09104	23270	11
50	9.76747	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	76765	90878	85887	14113	09122	23235	9
52	76782	90869	85911	14087	09131	23218	8
53	76800	90860	85940	14060	09140	23200	7
54	76817	90851	85967	14033	09149	23183	6
55	76835	90842	85993	14007	09158	23165	5
56	76852	90832	86020	13980	09168	23148	4
57	76870	90823	86046	13954	09177	23130	3
58	76887	90814	86073	13927	09186	23113	2
59	76904	90805	86100	13900	09195	23096	1
60	76922	90796	86126	13874	09204	23078	0
	Co-ſine	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

54 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co tang.	Secant.	Co-ſecant	
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	76939	90787	86153	13847	09213	23061	59
2	76957	90777	86179	13821	09223	23043	58
3	76974	90768	86206	13794	09232	23026	57
4	76991	90759	86232	13768	09241	23009	56
5	77009	90750	86259	13741	09250	22991	55
6	77026	90741	86285	13715	09259	22974	54
7	77043	90731	86312	13688	09269	22957	53
8	77061	90722	86338	13662	09278	22939	52
9	77078	90713	86365	1363	09287	22922	51
10	9.77095	9.90704	9.86392	10.13608	10.09296	10.22905	.50
11	77112	90694	86418	13582	09306	22888	49
12	77130	90685	86445	13555	09315	22870	48
13	77147	90676	86471	13529	09324	22853	47
14	77164	90667	86496	13502	09333	22836	46
15	77181	90657	86524	13476	09343	22819	45
16	77199	90648	86551	13449	09352	22801	44
17	77216	90639	86577	13423	09361	22784	43
18	77233	90630	86603	13397	09370	22767	42
19	77250	90620	86630	13370	09380	22750	41
20	9.77268	9.90611	9.86655	10.13344	10.09389	10.22732	40
21	77285	90602	86683	13317	09398	22715	39
22	77302	90592	86709	13291	09408	22698	38
23	77319	90583	86736	13264	09417	22681	37
24	77336	90574	86762	13238	09426	22664	36
25	77353	90565	86789	13211	09435	22647	35
26	77370	90555	86815	13185	09445	22630	34
27	77387	90546	86842	13158	09454	22613	33
28	77405	90537	868 8	13132	09463	22595	32
29	77422	90527	86894	13106	09473	22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	77456	90509	86947	13053	09491	22544	29
32	77473	90499	86974	13026	09501	22527	28
33	77490	90490	87000	13000	09510	22510	27
34	77507	90480	87027	12973	09520	22493	26
35	77524	90471	87053	12947	09529	22476	25
36	77541	90462	87079	12921	09538	22459	24
37	77558	90453	87106	12894	09548	22442	23
38	77575	90443	87132	12868	09557	22425	22
39	77 92	90434	87158	12842	09566	22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	77626	90415	87211	12789	09585	22374	19
42	77643	90405	87238	12762	09595	22357	18
43	77660	90396	87264	12736	09604	22340	17
44	77677	90386	87290	12710	09613	22324	16
45	77694	90377	87317	12683	09623	22306	15
46	77711	90368	87343	12657	09632	22289	14
47	77727	90358	87369	12631	09642	22272	13
48	77744	90349	87396	12604	09651	22256	12
49	77761	90339	87422	12578	09661	22239	11
50	9.77778	9.90330	9.87448	10.12552	10.09670	10.22222	10
51	77795	90320	87475	12525	09680	22205	9
52	77812	90311	87501	12499	09689	22188	8
53	77829	90301	87527	12473	09699	22171	7
54	77846	90292	87554	12446	09708	22154	6
55	77862	90282	87580	12420	09718	22138	5
56	77879	90273	87606	12394	09727	22121	4
57	77896	90263	87633	12307	09737	22104	3
58	77913	90254	87659	12341	09746	22087	2
59	77930	90244	87685	12315	09756	22070	1
60	77946	90235	87711	12289	09765	22054	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	60
1	77963	90225	87738	12262	09775	22037	59
2	77980	90216	87764	12236	09784	22020	58
3	77997	90206	87790	12210	09794	22003	57
4	78013	90197	87817	12183	09803	21987	56
5	78030	90187	87843	12157	09813	21970	55
6	78047	90178	87869	12131	09822	21953	54
7	78063	90168	87895	12105	09832	21937	53
8	78080	90159	87922	12078	09841	21920	52
9	78097	90149	87948	12052	09851	21903	51
10	9.78113	9.90139	9.87974	10.12026	10.09861	10.21887	50
11	78130	90130	88000	12000	09870	21870	49
12	78147	90120	88027	11973	09880	21853	48
13	78163	90111	88053	11947	09889	21837	47
14	78180	90101	88079	11921	09899	21820	46
15	78197	90091	88105	11895	09909	21803	45
16	78213	90082	88131	11869	09918	21787	44
17	78230	90072	88158	11842	09928	21770	43
18	78246	90063	88184	11816	09937	21754	42
19	78263	90053	88210	11790	09947	21737	41
20	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	78296	90034	88262	11738	09966	21704	39
22	78313	90024	88289	11711	09976	21687	38
23	78329	90014	88315	11685	09986	21671	37
24	78346	90005	88341	11659	09995	21654	36
25	78362	89995	88367	11633	10005	21638	35
26	78379	89985	88393	11607	10015	21621	34
27	78395	89976	88420	11580	10024	21605	33
28	78412	89966	88446	11554	10034	21588	32
29	78428	89956	88472	11528	10044	21572	31
30	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
31	78461	89937	88524	11476	10063	21539	29
32	78478	89927	88550	11450	10073	21522	28
33	78494	89917	88576	11424	10082	21506	27
34	78510	89908	88603	11397	10092	21490	26
35	78527	89898	88629	11371	10102	21473	25
36	78543	89888	88655	11345	10112	21457	24
37	78560	89879	88681	11319	10121	21440	23
38	78576	89869	88707	11293	10131	21424	22
39	78592	89859	88733	11267	10141	21408	21
40	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	78625	89840	88786	11214	10160	21375	19
42	78642	89830	88812	11188	10170	21358	18
43	78658	89820	88838	11162	10180	21342	17
44	78674	89810	88864	11136	10190	21326	16
45	78691	89801	88890	11110	10199	21309	15
46	78707	89791	88916	11084	10209	21293	14
47	78723	89781	88942	11058	10219	21277	13
48	78739	89771	88968	11032	10229	21261	12
49	78756	89761	88994	11006	10239	21244	11
50	9.78772	9.89752	9.89020	10.10980	10.10248	10.21228	10
51	78788	89742	89046	10954	10258	21212	9
52	78805	89732	89073	10927	10268	21195	8
53	78821	89722	89099	10901	10278	21179	7
54	78837	89712	89125	10875	10288	21163	6
55	78853	89702	89151	10849	10298	21147	5
56	78869	89693	89177	10823	10307	21131	4
57	78886	89683	89203	10797	10317	21114	3
58	78902	89673	89220	10771	10327	21098	2
59	78918	89663	89255	10745	10337	21082	1
60	78934	89653	89281	10719	10347	21066	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

52 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant.	
0	9.78934	9.89653	9.89281	10.10719	10.10347	10.21066	60
1	78950	89643	89307	10693	10357	21050	59
2	78967	89633	89333	10667	10367	21033	58
3	78983	89624	89359	10641	10376	21017	57
4	78999	89614	89385	10615	10386	21001	56
5	79015	89604	89411	10589	10396	20985	55
6	79031	89594	89437	10563	10406	20969	54
7	79047	89584	89463	10537	10416	20953	53
8	79063	89574	89489	10511	10426	20937	52
9	79079	89564	89515	10485	10436	20921	51
10	9.79095	9.89553	9.89541	10.10459	10.10446	10.20905	50
11	79111	89544	89567	10433	10456	20889	49
12	79128	89534	89593	10407	10466	20872	48
13	79144	89524	89619	10381	10476	20856	47
14	79160	89514	89645	10355	10486	20840	46
15	79176	89504	89671	10329	10496	20824	45
16	79192	89495	89697	10303	10505	20808	44
17	79208	89485	89723	10277	10515	20792	43
18	79224	89475	89749	10251	10525	20776	42
19	79240	89465	89775	10225	10535	20760	41
20	9.79256	9.89455	9.89801	10.10199	10.10545	10.20744	40
21	79272	89445	89827	10173	10555	20728	39
22	79288	89435	89853	10147	10565	20712	38
23	79304	89425	89879	10121	10575	20696	37
24	79319	89415	89905	10095	10585	20681	36
25	79335	89405	89931	10069	10595	20665	35
26	79351	89395	89957	10043	10605	20649	34
27	79367	89385	89983	10017	10615	20633	33
28	79383	89375	90009	09991	10625	20617	32
29	79399	89364	90035	09965	10636	20601	31
30	9.79415	9.89354	9.90060	10.09939	10.10646	10.20585	30
31	79431	89344	90086	09914	10656	20569	29
32	79447	89334	90112	09888	10666	20553	28
33	79463	89324	90138	09862	10676	20537	27
34	79478	89314	90164	09836	10686	20522	26
35	79494	89304	90190	09810	10696	20506	25
36	79510	89294	90216	09784	10706	20490	24
37	79526	89284	90242	39758	10716	20474	23
38	79542	89274	90268	09732	10726	20458	22
39	79558	89264	90294	09706	10736	20442	21
40	9.79573	9.89254	9.90320	10.09680	10.10746	10.20427	20
41	79589	89244	90346	09654	10756	20411	19
42	79605	89233	90371	09629	10767	20395	18
43	79621	89223	90397	09603	10777	20379	17
44	79636	89213	90423	09577	10787	20364	16
45	79652	89203	90449	09551	10797	20348	15
46	79668	89193	90475	09525	10807	20332	14
47	79684	89183	90501	09499	10817	20316	13
48	79699	89173	90523	09473	10827	20301	12
49	79715	89162	90553	09447	10838	20285	11
50	9.79731	9.89152	9.90578	10.09422	10.10848	10.20269	10
51	79746	89142	90604	09396	10858	20254	9
52	79762	89132	90630	09370	10868	20238	8
53	79778	89122	90656	09344	10878	20222	7
54	79793	89112	90682	09318	10888	20207	6
55	79809	89101	90708	09292	10899	20191	5
56	79825	89091	90734	09266	10909	20175	4
57	79840	89081	90759	09241	10919	20160	3
58	79856	89071	90785	09215	10929	20144	2
59	79872	89060	90811	09189	10940	20128	1
60	79887	89050	90837	09163	10950	20113	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

51 Degrees.

M.	Sine.	Co-fine	Tangent.	Co-tang	Secant.	Co-fecant	
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	79903	89040	90863	09137	10960	20097	59
2	79918	89030	90889	09111	10970	20082	58
3	79934	89020	90914	09086	10980	20066	57
4	79950	89009	90940	09060	10991	20050	56
5	79965	88999	90966	09034	11001	20035	55
6	79982	88989	90992	09008	11011	20019	54
7	79996	88978	91018	08982	11022	20004	53
8	80012	88968	91043	08957	11032	199 8	52
9	80027	88958	91069	08931	11042	19973	51
10	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	80058	88937	91121	08879	11063	19942	49
12	80074	88927	91147	08853	11073	19926	48
13	80089	88917	91172	08828	11083	19911	47
14	80105	88906	91198	08802	11094	19895	46
15	80120	88896	91224	08776	11104	19880	45
16	80136	88886	91250	08750	11114	19864	44
17	80151	88875	91276	08724	11125	19849	43
18	80166	88865	91301	08699	11135	19834	42
19	80182	88855	91327	08673	11145	19818	41
20	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	80213	88834	91379	08621	11166	19787	39
22	80228	88824	91404	08596	11176	19772	38
23	80244	88813	91430	08570	11187	19756	37
24	80259	88803	91456	08544	11197	19741	36
25	80274	88793	91482	08518	11207	19726	35
26	80290	88782	91507	08493	11218	19710	34
27	80305	88772	91533	08467	11228	19695	33
28	80320	88761	91559	08441	11239	19680	32
29	80336	88751	91585	08415	11249	19664	31
30	9.80351	9. 8741	9.91610	10.08390	10.11259	10.19649	30
31	80366	88730	91636	08364	11270	19634	29
32	80382	8 720	91662	08338	11280	19618	28
33	80397	88709	91688	08312	11291	19603	27
34	80412	88699	91713	08287	11301	19588	26
35	80428	88688	91739	08261	11312	19572	25
36	80443	88678	91765	08235	11322	19557	24
37	80458	88668	91791	08209	11332	19542	23
38	80473	88657	91816	08184	11343	19527	22
39	80489	88647	91842	08158	11353	19511	21
40	9.80504	9.88636	9.91868	10.08132	10.11364	10.19496	20
41	80519	88626	91893	08107	11374	19482	19
42	80534	88615	91919	08081	11385	19466	18
43	80550	88605	91945	08055	11395	19450	17
44	80565	88594	91971	08029	11406	19435	16
45	80580	88584	91996	08004	11416	19420	15
46	80595	88573	92022	07978	11427	19405	14
47	80610	88563	92048	07952	1143	19390	13
48	80625	88552	92073	07927	11448	19375	12
49	80641	88542	92099	07901	11458	19359	11
50	9.80656	9.88531	9.92125	10.07875	10.11469	10.19344	10
51	80671	88521	92150	07850	11472	19329	9
52	80686	88510	92176	07824	11490	19314	8
53	80701	88499	92202	07798	11501	19299	7
54	80716	88489	92227	07773	11511	19294	6
55	80731	88478	92253	07747	11522	19269	5
56	80746	88468	92279	07721	11532	19254	4
57	80762	88457	92304	07696	11543	19238	3
58	80777	88447	92330	07670	11553	19223	2
59	80792	88436	92356	07644	11564	19208	1
60	80807	88425	92381	07619	11575	19193	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

50 Degrees.

M.	Sine.	Co fine.	Tangent.	Co tang.	Secant.	Co-fecant	
0	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	60
1	80822	88415	92407	07593	11585	19178	59
2	80837	88404	92433	07567	11596	19163	58
3	80852	88394	92458	07542	11606	19148	57
4	80867	88383	92484	07516	11617	19133	56
5	80882	88372	92510	07490	11628	19118	55
6	80897	88362	92535	07465	11638	19103	54
7	80912	88351	92561	07439	11649	19088	53
8	80927	88340	92587	07413	11660	19073	52
9	80942	88330	92612	07388	11670	19058	51
10	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	80972	88308	92663	07337	11692	19028	49
12	80987	88298	92689	07311	11702	19013	48
13	81002	88287	92715	07285	11713	18998	47
14	81017	88276	92740	07260	11724	18983	46
15	81032	88266	92766	07234	11734	18968	45
16	81046	88255	92792	07208	11745	18954	44
17	81061	88244	92817	07183	11756	18939	43
18	81076	88234	92843	07157	11766	18924	42
19	81091	88223	92868	07132	11777	18909	41
20	9.81106	9.88212	9.92894	10.07106	10.11788	10.18894	40
21	81121	88201	92920	07080	11799	18879	39
22	81136	88191	92945	07055	11809	18864	38
23	81151	88180	92971	07029	11820	18849	37
24	81166	88169	92996	07004	11831	18834	36
25	81180	88158	93022	06978	11842	18820	35
26	81195	88148	93048	06952	11852	18805	34
27	81210	88137	93073	06927	11863	18790	33
28	81225	88126	93099	06901	11874	18775	32
29	81240	88115	93124	06876	11885	18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
31	81269	88094	93175	06825	11906	18731	29
32	81284	88083	93201	06799	11917	18716	28
33	81299	88072	93227	06733	11928	18701	27
34	81314	88061	93252	06748	11939	18686	26
35	81328	88050	93278	06722	11949	18672	25
36	81343	88040	93303	06697	11960	18657	24
37	81358	88029	93329	06671	11971	18642	23
38	81372	88018	93354	06646	11982	18628	22
39	81387	88007	93380	06620	11993	18613	21
40	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	81417	87985	93431	06569	12015	18583	19
42	81431	87975	93457	06543	12025	18569	18
43	81446	87964	93482	06518	12036	18554	17
44	81461	87953	93508	06492	12047	18539	16
45	81475	87942	93533	06467	12058	18525	15
46	81490	87931	93559	06441	12069	18510	14
47	81505	87920	93584	06416	12080	18495	13
48	81519	87909	93610	06390	12091	18481	12
49	81534	87898	93635	06364	12102	18466	11
50	9.81549	9.87887	9.93661	10.06339	10.12113	10.18451	10
51	81563	87877	93687	06313	12123	18437	9
52	81578	87866	93712	06288	12134	18422	8
53	81592	87855	93738	06262	12145	18408	7
54	81607	87844	93763	06237	12156	18393	6
55	81622	87833	93789	06211	12167	18378	5
56	81636	87822	93814	06186	12178	18364	4
57	81651	87811	93849	06160	12189	18349	3
58	81665	87800	93865	06135	12200	18335	2
59	81680	87789	93891	06109	12211	18320	1
60	81694	87778	93916	06084	12222	18306	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

49 Degrees.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.81694	9.87778	9.93916	10.06084	10.12222	10.18306	60
1	81709	87767	93942	06058	12233	18291	59
2	81723	87756	93967	06033	12244	18277	58
3	81738	87745	93993	06007	12255	18262	57
4	81752	87734	94018	05982	12266	18248	56
5	81767	87723	94044	05956	12277	18233	55
6	81781	87712	94069	05931	12288	18219	54
7	81796	87701	94095	05905	12299	18204	53
8	81810	87660	94120	05880	12310	18190	52
9	81825	87679	94146	05854	12321	18175	51
10	9.81839	9.87668	9.94171	10.05829	10.12332	10.18161	50
11	81854	87657	94197	05803	12343	18146	49
12	81868	87646	94222	05778	12354	18132	48
13	81882	87635	94248	05752	12365	18118	47
14	81897	87624	94273	05727	12376	18103	46
15	81911	87613	94299	05701	12387	18089	45
16	81926	87601	94324	05676	12399	18074	44
17	81940	87590	94350	05650	12410	18060	43
18	81954	87579	94375	05625	12421	18046	42
19	81969	87568	94401	05599	12432	18031	41
20	9.81983	9.87557	9.94426	10.05574	10.12443	10.18017	40
21	81998	87546	94452	05548	12454	18002	39
22	82012	87535	94477	05523	12465	17988	38
23	82026	87524	94503	05497	12476	17974	37
24	82041	87513	94528	05472	12487	17959	36
25	82055	87501	94554	05446	12499	17945	35
26	82069	87490	94579	05421	12510	17931	34
27	82084	87479	94604	05396	12521	17916	33
28	82098	87468	94630	05370	12532	17902	32
29	82112	87457	94655	05345	12543	17888	31
30	9.82126	9.87446	9.94681	10.05319	10.12554	10.17874	30
31	82141	87434	94706	05294	12566	17859	29
32	82155	87423	94732	05268	12577	17845	28
33	82169	87412	94757	05243	12588	17831	27
34	82184	87401	94783	05217	12599	17816	26
35	82198	87390	94808	05192	12610	17802	25
36	82212	87378	94834	05166	12622	17788	24
37	82226	87367	94859	05141	12633	17774	23
38	82240	87356	94884	05116	12644	17760	22
39	82255	87345	94910	05090	12655	17745	21
40	9.82269	9.87334	9.94935	10.05065	10.12666	10.17731	20
41	82283	87322	94961	05039	12678	17717	19
42	82297	87311	94986	05014	12689	17703	18
43	82311	87300	95012	04988	12700	17689	17
44	82326	87288	95037	04963	12711	17674	16
45	82340	87277	95062	04938	12723	17660	15
46	82354	87266	95088	04912	12734	17646	14
47	82368	87255	95113	04887	12745	17632	13
48	82382	87243	95139	04861	12757	17618	12
49	82396	87232	95164	04836	12768	17604	11
50	9.82410	9.87221	9.95190	10.04810	10.12779	10.17590	10
51	82424	87209	95215	04785	12791	17576	9
52	82439	87198	95240	04760	12802	17561	8
53	82453	87187	95266	04734	12813	17547	7
54	82467	87175	95291	04709	12825	17533	6
55	82481	87164	95317	04683	12836	17519	5
56	82495	87153	95342	04658	12847	17505	4
57	82509	87141	95368	04632	12859	17491	3
58	82523	87130	95393	04607	12870	17477	2
59	82537	87119	95418	04582	12881	17463	1
60	82551	87107	95444	04556	12893	17449	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

48 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	60
1	82565	87096	95469	04531	12904	17435	59
2	82579	87085	95495	04505	12915	17421	58
3	82593	87073	95520	04480	12927	17407	57
4	82607	87062	95545	04455	12938	17393	56
5	82621	87050	95571	04430	12950	17379	55
6	82635	87039	95596	04404	12961	17365	54
7	82649	87028	95621	04378	12972	17351	53
8	82663	87016	95647	04353	12984	17337	52
9	82677	87005	95672	04328	12995	17323	51
10	9.82691	9.86993	9.95698	10.04302	10.13007	10.17309	50
11	82705	86982	95723	04277	13018	17295	49
12	82719	86970	95748	04252	13030	17281	48
13	82733	86959	95774	04226	13041	17267	47
14	82747	86947	95799	04201	13053	17253	46
15	82761	86936	95825	04175	13064	17239	45
16	82775	86924	95850	04150	13076	17226	44
17	82788	86913	95875	04125	13087	17212	43
18	82802	86902	95901	04099	13098	17198	42
19	82816	86890	95926	04074	13110	17184	41
20	9.82830	9.86879	9.95952	10.04048	10.13121	10.17170	40
21	82844	86867	95977	04023	13133	17156	39
22	82858	86855	96002	03998	13145	17142	38
23	82872	86844	96028	03972	13156	17128	37
24	82885	86832	96053	03947	13168	17115	36
25	82899	86821	96078	03922	13170	17101	35
26	82913	86809	96104	03896	13191	17087	34
27	82927	86798	96129	03871	13202	17073	33
28	82941	86786	96155	03845	13214	17059	32
29	82955	86775	96180	03820	13225	17045	31
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	82982	86752	96231	03769	13248	17018	29
32	82996	86740	96256	03744	13260	17004	28
33	83010	86728	96281	03719	13272	16990	27
34	83023	86717	96307	03693	13283	16977	26
35	83037	86705	96332	03668	13295	16963	25
36	83051	86694	96357	03643	13306	16949	24
37	83065	86682	96383	03617	13318	16935	23
38	83078	86670	96408	03592	13330	16922	22
39	83092	86659	96433	03567	13341	16908	21
40	9.83106	9.86647	9.96459	10.03541	10.13353	10.16894	20
41	83119	86635	96484	03516	13365	16880	19
42	83133	86624	96510	03490	13376	16867	18
43	83147	86612	96535	03465	13388	16853	17
44	83161	86600	96560	03440	13400	16839	16
45	83174	86589	96586	03414	13411	16826	15
46	83188	86577	96611	03389	13423	16812	14
47	83202	86565	96636	03364	13435	16798	13
48	83215	86554	96662	03338	13446	16785	12
49	83229	86542	96687	03313	13458	16771	11
50	9.83242	9.86530	9.96712	10.03288	10.13470	10.16758	10
51	83256	86518	96738	03262	13482	16744	9
52	83270	86507	96763	03237	13493	16730	8
53	83283	86495	96788	03212	13505	16717	7
54	83297	86483	96814	03186	13517	16703	6
55	83310	86472	96839	03161	13528	16690	5
56	83324	86460	96864	03136	13540	16676	4
57	83338	86448	96890	03110	13552	16662	3
58	83351	86436	96915	03085	13564	16649	2
59	83365	86425	96940	03060	13575	16635	1
60	83378	86413	96966	03034	13587	16622	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.83578	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	83392	86401	96991	03009	13599	16608	59
2	83405	86389	97016	02984	13611	16595	58
3	83419	86377	97042	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16568	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16541	54
7	83473	86330	97143	02857	13670	16527	53
8	83486	86318	97168	02832	13682	16513	52
9	83500	86306	97193	02807	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97294	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83607	86211	97396	02604	13789	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	19326	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02402	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	83795	86044	97750	02250	13956	16205	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16116	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16113	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	83927	85924	98003	01999	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01744	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84098	85766	98332	01668	14234	15902	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

46 Degrees.

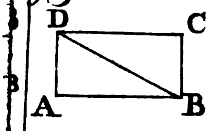
M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	60
1	84190	85681	98509	01491	14319	15810	59
2	84203	85669	98534	01466	14331	15797	58
3	84216	85657	98560	01440	14343	15784	57
4	84229	85645	98585	01415	14355	15771	56
5	84242	85632	98610	01390	14368	15758	55
6	84255	85620	98635	01365	14380	15745	54
7	84269	85608	98661	01339	14392	15731	53
8	84282	85596	98686	01314	14404	15718	52
9	84295	85583	98711	01289	14417	15705	51
10	9.84308	9.85571	9.98737	10.01263	10.14429	10.15692	50
11	84321	85559	98762	01238	14441	15679	49
12	84334	85546	98787	01213	14454	15666	48
13	84347	85534	98812	01188	14466	15653	47
14	84360	85522	98838	01162	14478	15640	46
15	84372	85510	98863	01137	14490	15627	45
16	84385	85497	98888	01112	14503	15614	44
17	84398	85485	98913	01087	14515	15602	43
18	84411	85473	98939	01061	14527	15589	42
19	84424	85460	98964	01036	14540	15576	41
20	9.84437	9.85448	9.98989	10.01011	10.14552	10.15563	40
21	84450	85436	99014	00985	14564	15550	39
22	84463	85423	99040	00960	14577	15537	38
23	84476	85411	99065	00935	14589	15524	37
24	84489	85399	99090	00910	14601	15511	36
25	84502	85386	99116	00884	14614	15498	35
26	84515	85374	99141	00859	14626	15485	34
27	84528	85361	99166	00834	14639	15472	33
28	84540	85349	99191	00809	14651	15460	32
29	84553	85337	99217	00783	14663	15447	31
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	84579	85312	99267	00733	14688	15421	29
32	84592	85299	99293	00707	14701	15408	28
33	84605	85287	99318	00682	14713	15395	27
34	84618	85274	99343	00657	14726	15382	26
35	84630	85262	99368	00632	14738	15370	25
36	84643	85250	99394	00606	14750	15357	24
37	84656	85237	99419	00581	14763	15344	23
38	84669	85225	99444	00556	14775	15331	22
39	84682	85212	99469	00531	14788	15318	21
40	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	84707	85187	99520	00480	14813	15293	19
42	84720	85175	99545	00455	14825	15280	18
43	84733	85162	99570	00430	14838	15267	17
44	84745	85150	99596	00404	14850	15255	16
45	84758	85137	99621	00379	14863	15242	15
46	84771	85125	99646	00354	14875	15229	14
47	84784	85112	99672	00328	14888	15216	13
48	84796	85100	99697	00303	14900	15204	12
49	84809	85087	99722	00278	14913	15191	11
50	9.84822	9.85074	9.99747	10.00253	10.14926	10.15178	10
51	84834	85062	99773	00227	14938	15166	9
52	84847	85049	99798	00202	14951	15153	8
53	84860	85037	99823	00177	14963	15140	7
54	84873	85024	99848	00152	14976	15127	6
55	84885	85012	99874	00126	14988	15115	5
56	84898	84999	99899	00101	15001	15102	4
57	84911	84986	99924	00076	15014	15089	3
58	84923	84974	99949	00051	15026	15077	2
59	84936	84961	99975	00025	15039	15064	1
60	84948	84948	10.00000	10.00000	15052	15051	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

45 Degrees.

F I N I S.

I

f3



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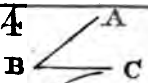

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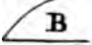

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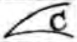

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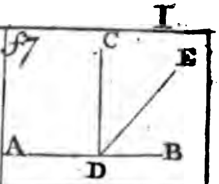

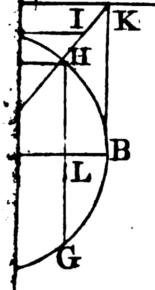

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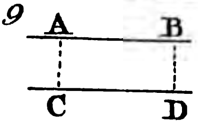

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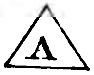

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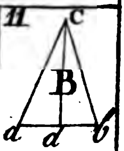

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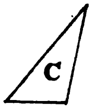

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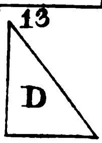

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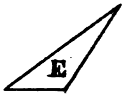

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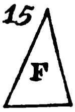

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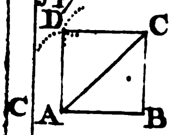

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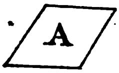

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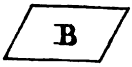

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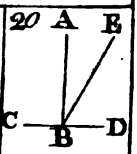

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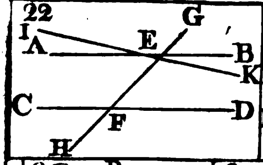

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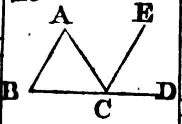

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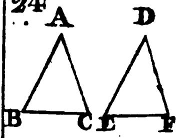

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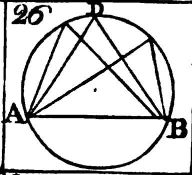

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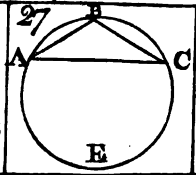

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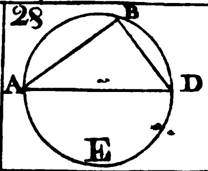

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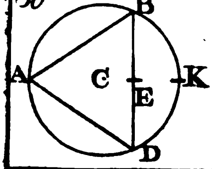

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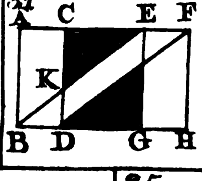

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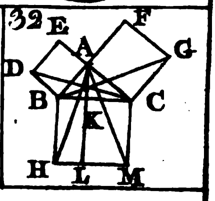

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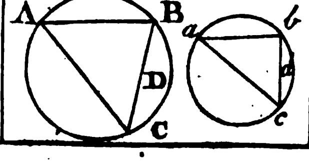

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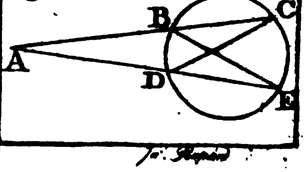

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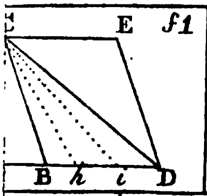
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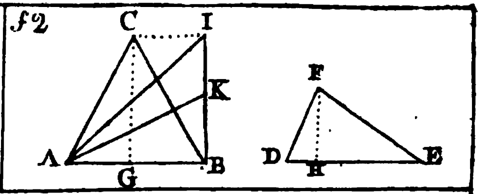
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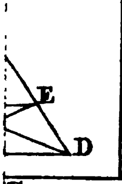
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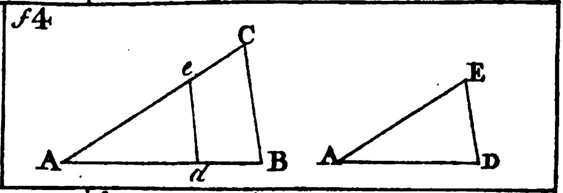
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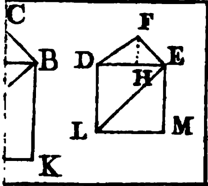
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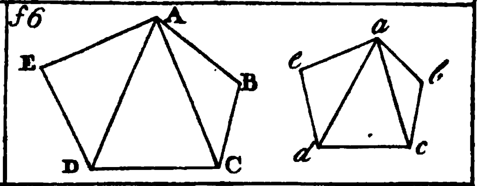
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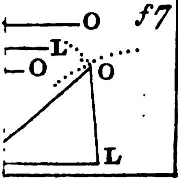
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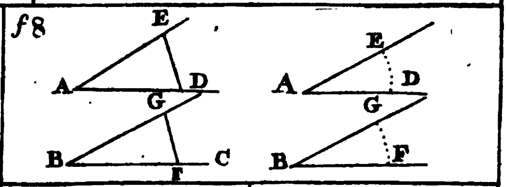
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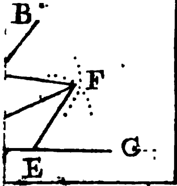
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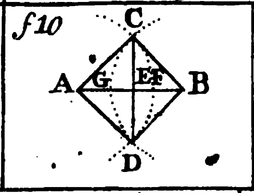
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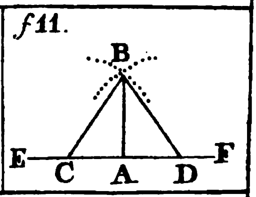
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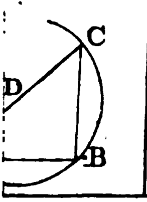
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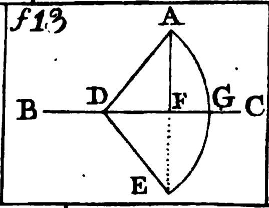
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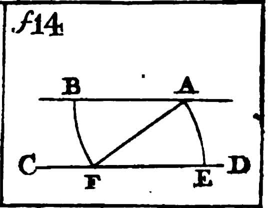
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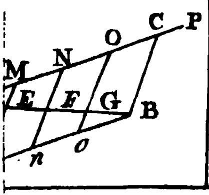
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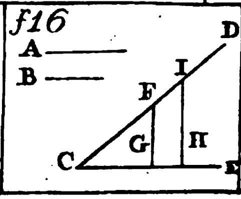
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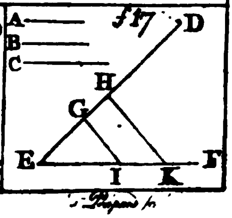
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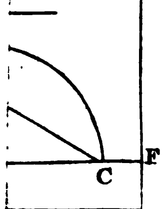
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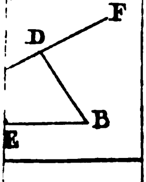
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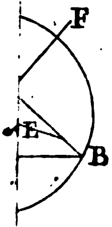
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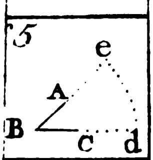
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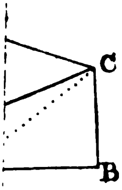
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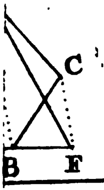
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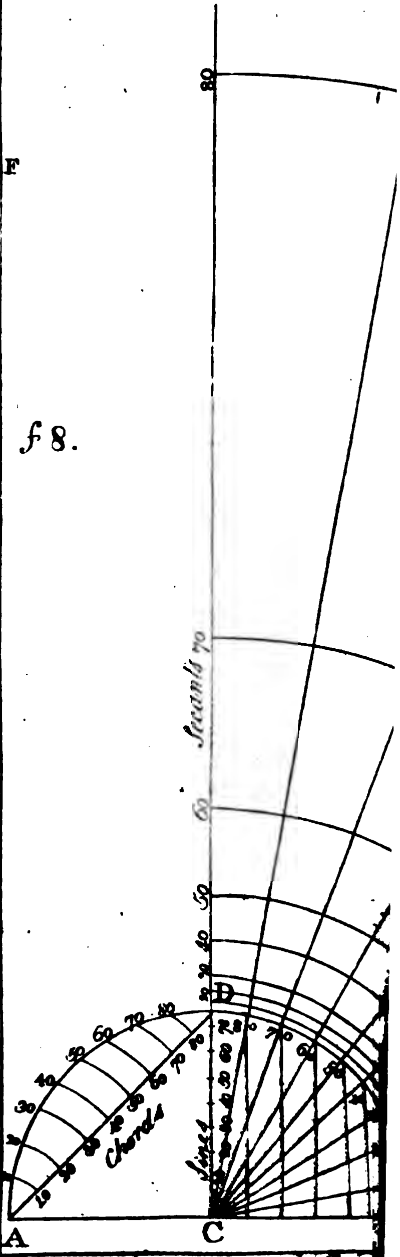
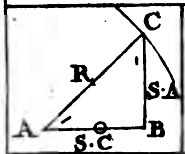
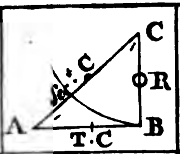
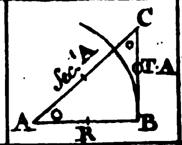
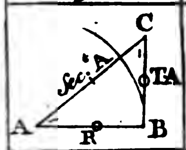
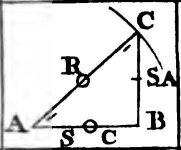
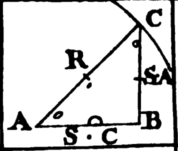
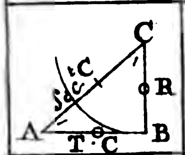
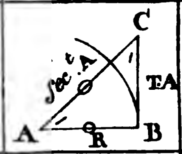
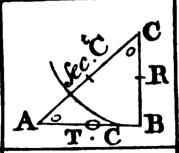
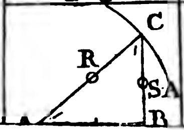
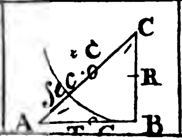
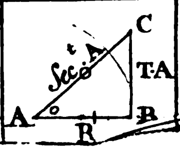

Secants 70
D
Chords
Sines
A
C

The Proportions for the Solution of 6 Cases of Right Angled Plane Triangles.

	*Case 1.* R:AC::SA:BC R:AC::SC:AB		TC:AB::R:BC TC:AB::Sec^{t}C:AC		AB:R::AC:Sec^{t}A R:AB::TA:BC
	Sec^{t}A:AC::R:AB Sec^{t}A:AC::TA:BC		*Case 3.* SA:BC::R:AC SA:BC::SC:AB		*Case 5.* AC:R::BC:SA R:AC::S.C:AB
	Sec^{t}C:AC::R:BC Sec^{t}C:AC::TC:AB		TA:BC::R:AB TA:BC::Sec^{t}A:AC		BC:R::AC:Sec^{t}C R:BC::T.C:AB
	*Case 2.* S.C:AB::R:AC S.C:AB::SA:BC		R:BC::TC:AB R:BC::Sec^{t}C:AC		*Case 6.* AB:R::BC:TA R:AB

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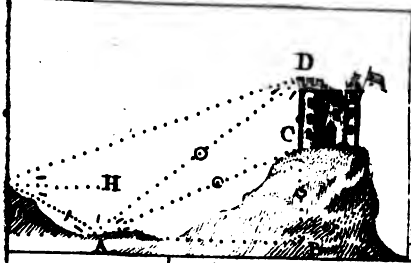

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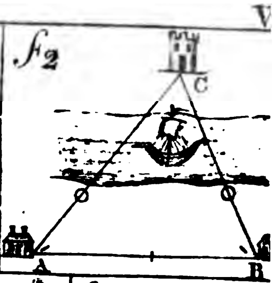

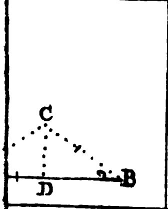

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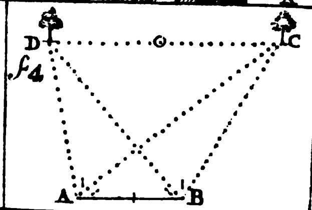

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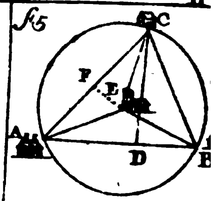

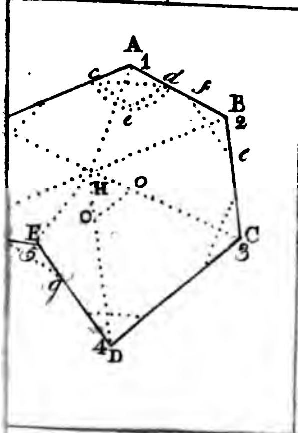

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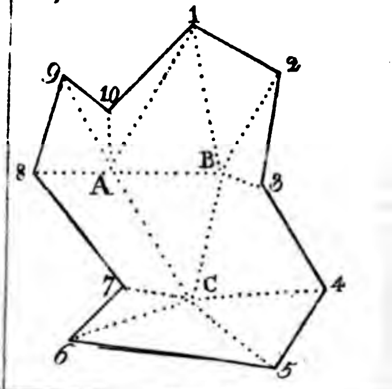

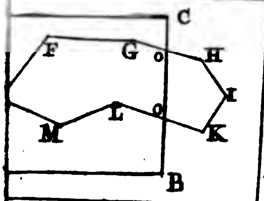

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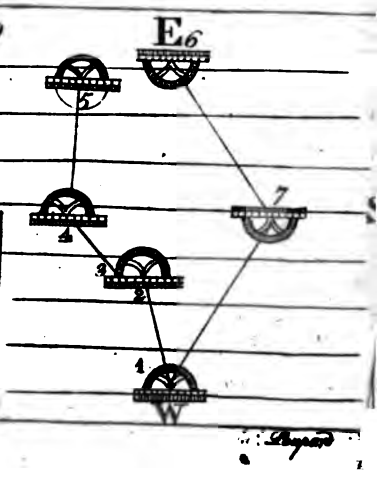

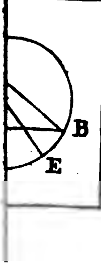

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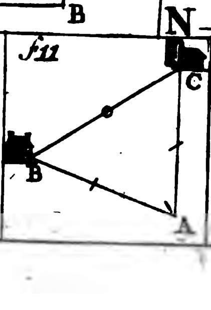

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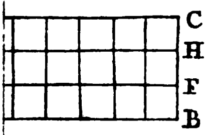

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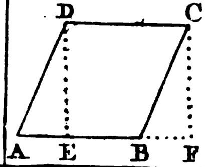

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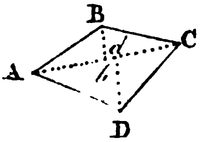

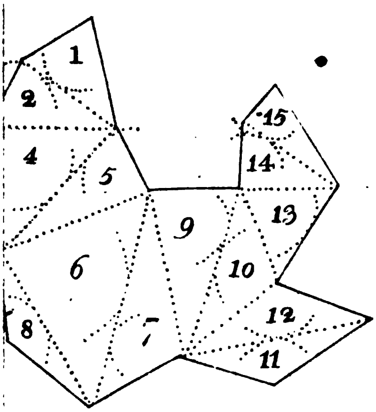

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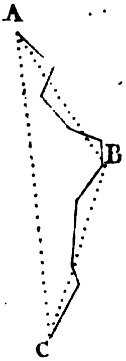

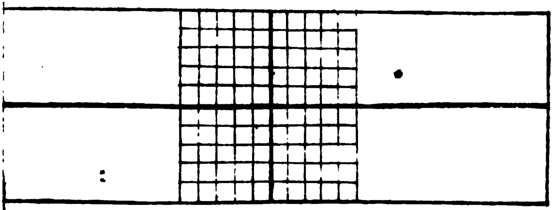

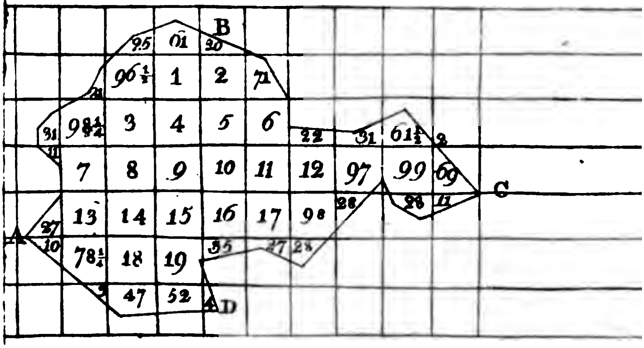

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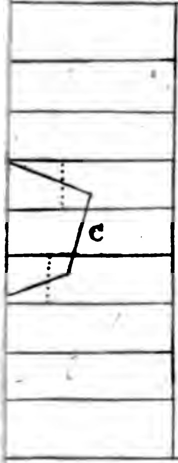

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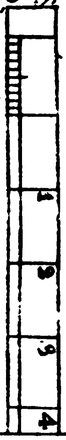

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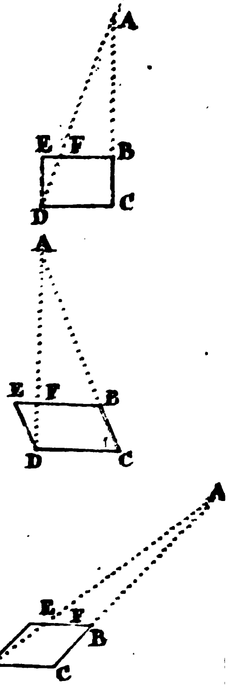

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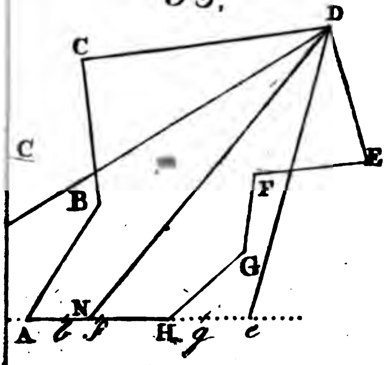

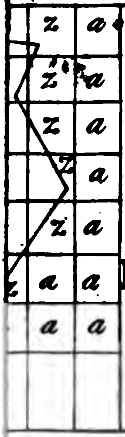

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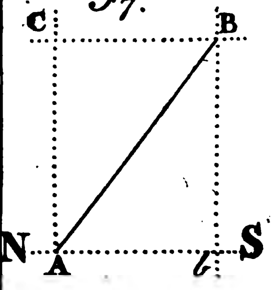

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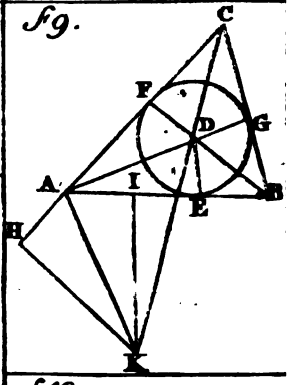

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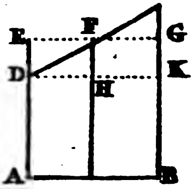

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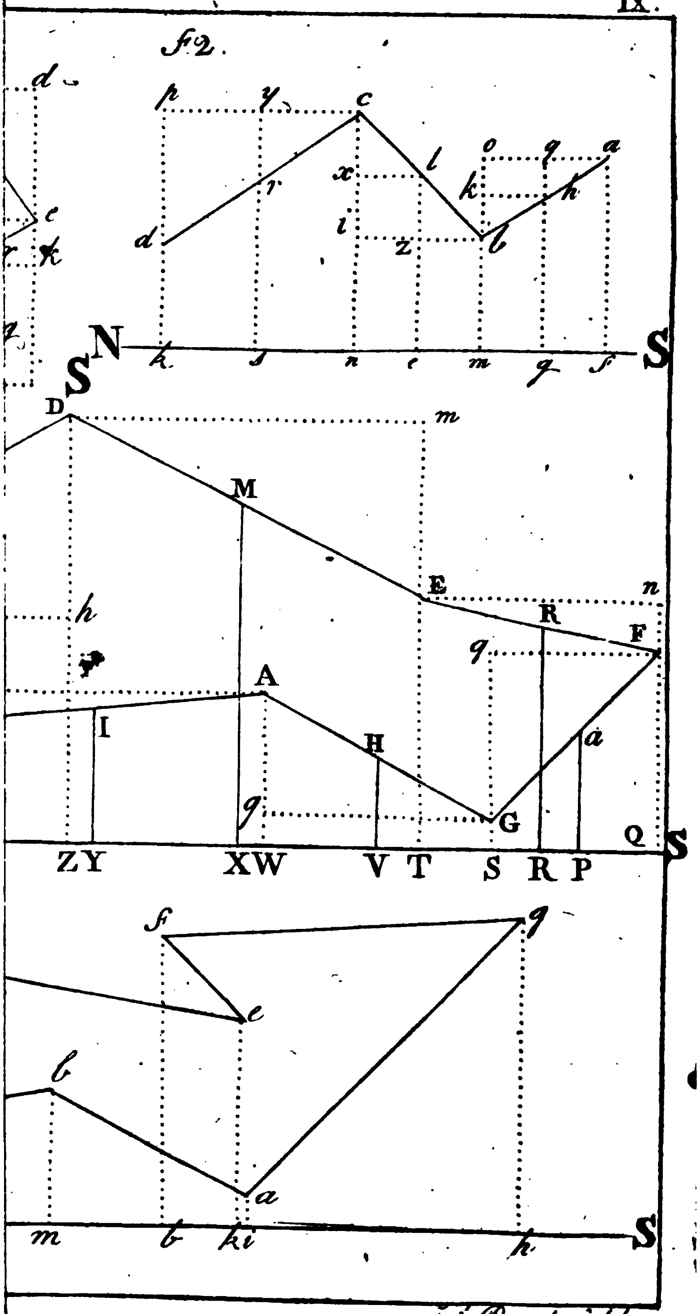

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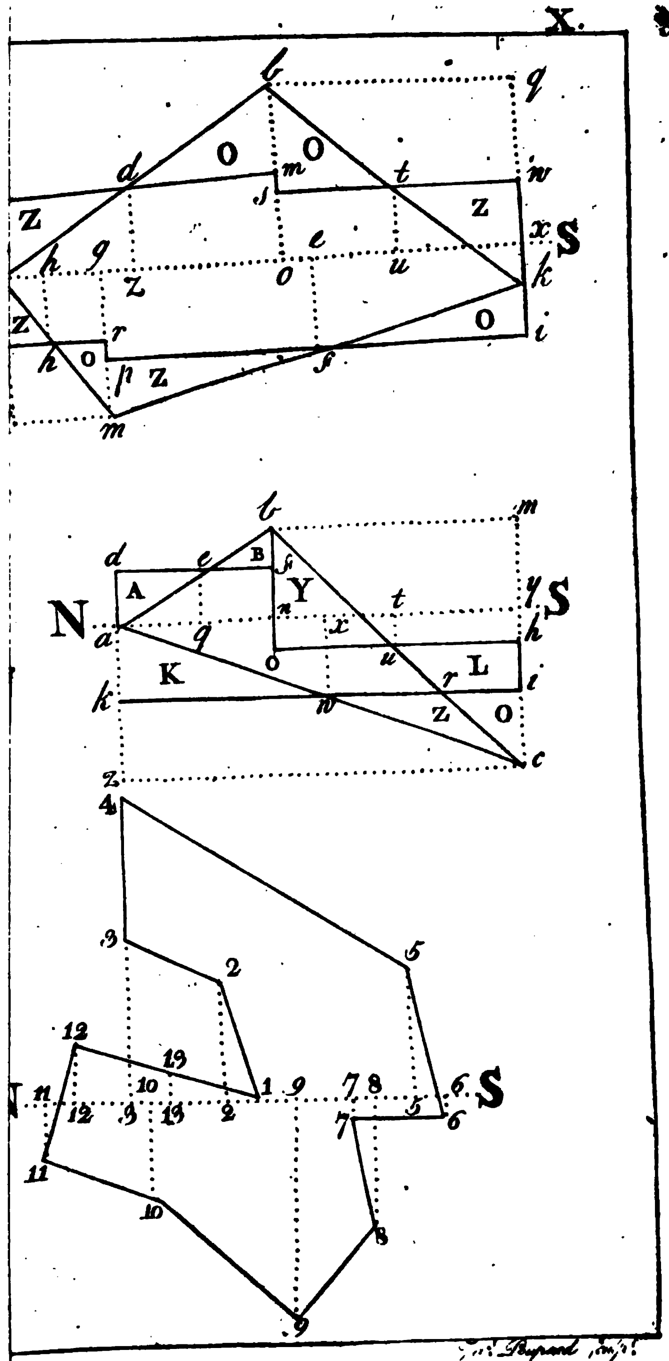

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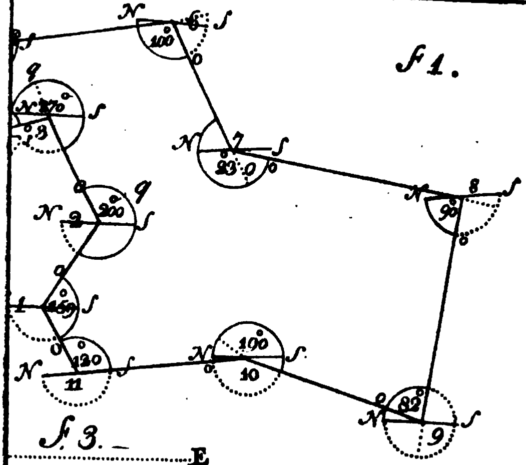

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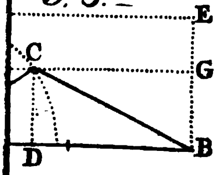

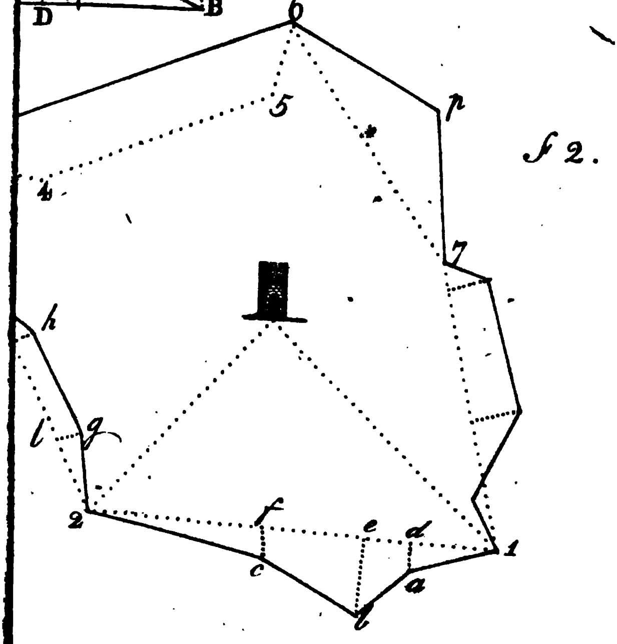

f 2.

J.r Reynaud sculp.

XII.

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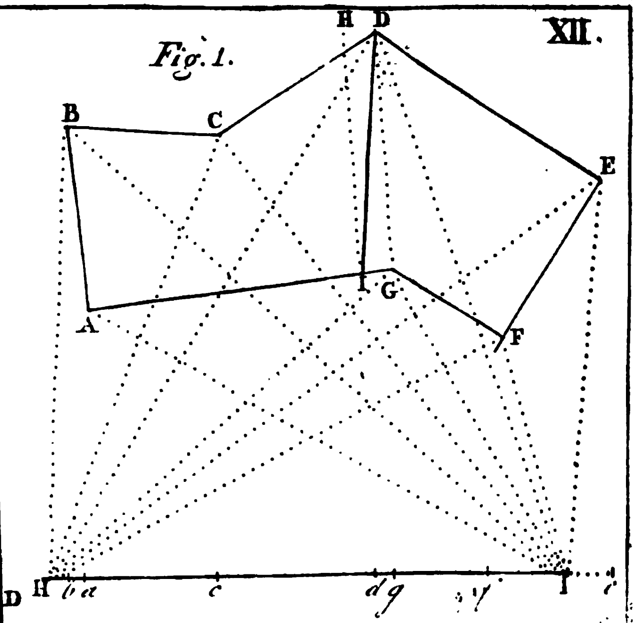

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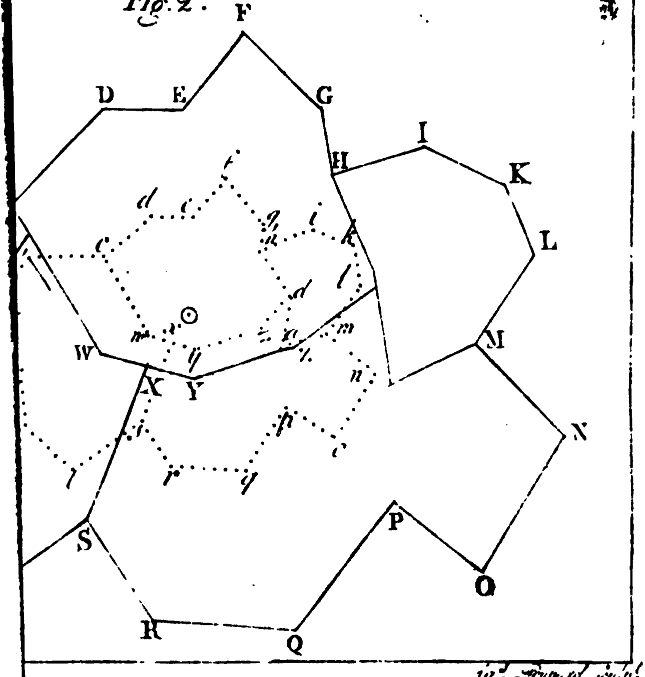

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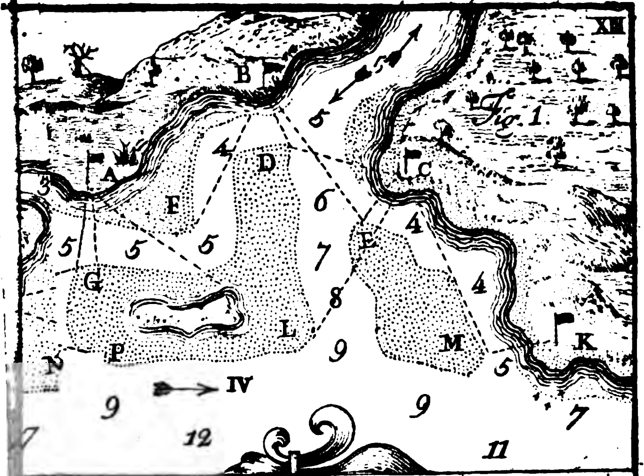
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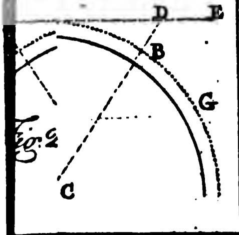
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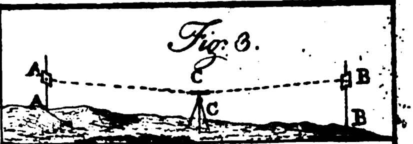
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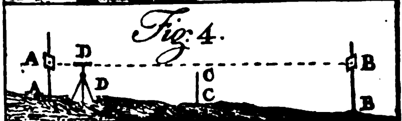
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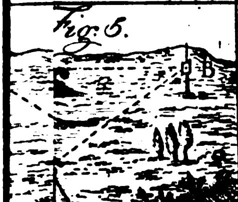
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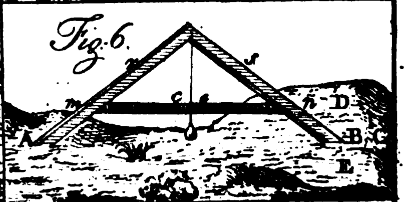
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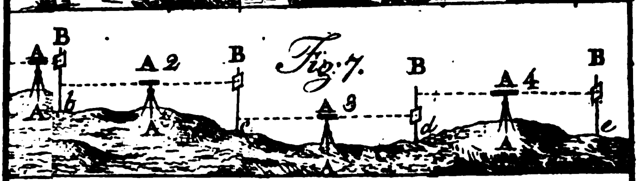
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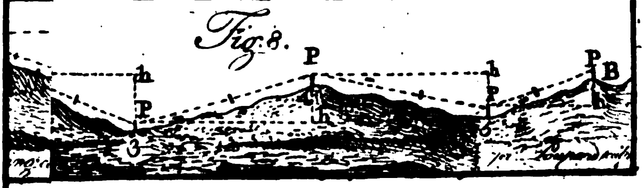
Fig. 8.